PHONEMES, MORPHEMES AND LITERACY DEVELOPMENT: EVIDENCE FROM GREEK

Athanasios Aidinis

Department of Child Development and Learning

Institute of Education

University of London

Thesis submitted for the degree of Doctor of Philosophy

September 1998

ABSTRACT

It has been proposed that literacy development follows a sequence from simple to complex rules: children acquire simple phonological rules before they learn more complex orthographic rules such as conditional rules or morphological rules. I hypothesise that Greek children start reading and spelling by using a simple phonological strategy and later develop more complex phonological and morphological strategies. The hypothesis that young children fail to use complex phonological and morphological rules, the processes involved in reading words with complex phonological rules, the predictors of children's use of morphological strategies in spelling and the relations between different instances of morphological spellings were investigated in six studies.

In the first three studies the hypothesis that young children fail to use complex phonological strategies in reading and the processes involved in reading words which involve complex rules were examined. Children (6-8 years) were asked to read words and non-words (analogous and not-analogous to real words) either in isolation or in the context of a sentence, assigned to three categories in terms of the rules involved in reading them. The children - especially the younger ones - performed better in words and non-words that involve constant relations between graphemes and phonemes than in words and non-words that involve variant relations between graphemes and phonemes. All the age groups performed better in the analogous non-words that involve complex phonological rules than in the not-analogous non-words. Children and adults read words that involve variant but predictable spelling patterns either by establishing connections to whole words or segments of known words. Younger children benefited more from context than the older ones and the effect was bigger for more difficult words.

In the fourth study the hypothesis that younger children fail to use morphological strategies in spelling was tested. Children (7-10 years) were given a task involving three instances of spelling of the final morpheme. Young children spelled the final morpheme using phonological strategies while older children used morphological ones. In the last two studies, children (7-10 years) were given oral measures of grammatical awareness, a standardised verbal ability test, measures of grammatical spelling knowledge and a measure of their ability to interpret novel words. Significant correlations between grammatical awareness, different instances of morphological spelling and children's ability to interpret novel words were found even after age and verbal ability were partialled out.

I conclude that even in a language that is transparent (at least from spelling to phonology) a stage model of simple rules first, complex rules later still holds. In reading, complex phonological strategies must be acquired for the reading of words that involve conditional rules. Morphological spelling strategies are important for correct spelling in Greek (which is not transparent from phonology to spelling) and their development is highly correlated with children's grammatical awareness.

ACKNOWLEDGEMENTS

I am grateful to those people who helped me during the course of this thesis. Firstly, my special thanks are due to my mother and father for their support and sacrifice during my entire life and especially during the years of my studies. Their confidence, advice and encouragement put me on to the path of academic success.

I would particularly like to thank my supervisor, Prof. Terezinha Nunes, who has given me her valuable time during the course of this thesis. Her friendly attitude and critical approach to this work, her advice and insight have helped me get a deeper understanding of the issues involved. It was a privilege and a pleasure to be supervised by her.

I would also like to thank Prof. Peter Bryant at the university of Oxford for his useful comments at various stages of this thesis.

At the Institute of Education, I would like to thank Angella Hobsbaum for her invaluable comments and editing many chapters of the present thesis and Dr. Richard Cowan for his help with my upgrading.

I am also grateful to Prof. Michele Fayol for his comments and advice during our discussions in conferences.

Many thanks also to Anna Brett, who was more than a secretary, for her help and advice during the course of my studies.

I would also like to thank the State Scholarships Foundation of the Republic of Greece (I.K.Y.) for its financial support during the years of my studies. I am also grateful to Prof. I. Paraskevopoulos at the university of Athens, who was my I.K.Y.

supervisor, for his generous permission to use parts of the Athena test.

I would like to express my thanks to the headteachers and the teachers of the schools of Katerini who welcomed me into their schools and allowed me to take children out of their lesson. I would like also to thank the children who took part in the study for their hard work, enthusiasm and cooperation.

And above all, my heartfelt thanks go to my fiancee Despina Desli for her patience, support and constant interest throughout the study. Her emotional and practical support have sustained and nourished me throughout.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF APPENDICES

INTRODUCTION

In this thesis, the hypothesis that literacy development starts from simple basic rules whereas the more complex sophisticated rules are learned later is examined in connection with the Greek language. In English, a stage model from simple to complex has been proposed for literacy development by a number of researchers (Nunes, Bryant and Bindman, 1997; Frith, 1985; Marsh, Friedman, Welch and Desberg, 1980). However, in every alphabetic script there are both general and specific features of the represented language which influence the acquisition of reading and spelling. Thereby the findings of this thesis will contribute both to our understanding of general processes and to the description of literacy acquisition in Greek.

Any study of literacy development is carried out in a particular language. To disentangle general from specific aspects of literacy development in alphabetic scripts, cross-linguistic comparisons are needed. Languages may vary in the complexity of their phonological structure (for example, in the diversity of their syllable types), but also in the ways in which orthography represents the structure of the language (for example, in the constancy of letter-sound correspondences). Perfetti (1997), suggested that the transparency of an orthography has two components: the transparency of the phonology through spelling and the transparency of the spelling through the phonology. He further suggested that an orthography may be symmetrically transparent, when both components of transparency are present, or asymmetrically transparent, when only one component, usually the second one, is present.

I. Does reading develop from simple to complex rules in a transparent orthography?

Theories of literacy development propose that children learning to read and write in English go through an "alphabetic" phase (Frith, 1985; Marsh et al., 1981; Treiman, 1993), where they learn the simple rules, before they learn the more complex rules that characterise the "orthographic" phase (Frith, 1985; Marsh et al., 1985; Beers and Beers, 1992; Schlagal, 1992; Bryant, Devine, Ledward and Nunes, 1997; Bryant, Nunes and Bindman, 1997; Nunes, Bryant and Bindman, 1997). Frith (1985), for example, has proposed that during the alphabetic phase children learn about the basic relationships between letters and sounds and only later during the orthographic phase do they grasp the higher order, more sophisticated aspects of their language. A similar distinction about an early stage in which children master letter-sound correspondences and more advanced stages in which they grasp more sophisticated aspects of reading and spelling has been made by Marsh et al. (1980). The shifting from one phase to another is characterised by the acquisition of new strategies that children can use. However, the acquisition of new strategies does not necessarily imply that earlier acquired strategies cannot be used (Frith, 1985).

I propose to test this theory in the Greek language through an analysis of the specific characteristics of the language. Greek is a shallow orthography for reading with few complex rules. Greek language involves both simple, invariant letter-sound rules and spelling patterns called "variant but predictable" (Venezky, 1995). These latter rules have also been called "hierarchical" or "conditional" (Marsh et al., 1981) to indicate that, if a certain condition applies, orthography will depart from the simple rules in a predictable way. Some of these variable but predictable spelling patterns have to do with the representation of sounds: e.g. in the αυ-ευ combinations the second letter is pronounced as /f/ or /v/ (which are

commonly represented by the letters "φ" and "β" respectively) depending on the subsequent letter (whether it is a voiced consonant or a vowel, or a voiceless consonant).

In exemplifying the distinction between words that involve conditional rules and irregular words, Treiman (1993), argued that the existence of one-to-many relations between phonemes and graphemes by itself does not make a group of words irregular. For example, if the phoneme /a/ is spelled as 'a' in some words and as 'u' in some other, and there is a rule which says that at the beginning of the words the phoneme /a/ is spelled with 'a' and at the end of the words is spelled with 'u' then a child who knows the rule can read or write any word that contains this phoneme. In this sense, irregular words could be characterised as those that violate the rule and have 'u' at the beginning. These are the words that involve variant unpredictable spelling patterns (Venezky, 1995). Unfortunately, in the English writing system, rule plus exception words are often found in contrast with Greek where they are very rare. The existence, however, of both invariant and variant but predictable spelling patterns in the Greek language, although it eliminates the presence of a group of irregular words, leads to a further distinction of the regular words in terms of the relation between graphemes and phonemes.

The shallowness of the Greek orthography for reading and the absence of irregular words leads to the question of whether a stage model from simple to complex rules will still hold for reading. Studies of the development of reading in Greek support the hypothesis that children seem to employ phonological strategies in their reading and spelling right from the beginning of schooling (Porpodas, 1993). Even in the upper grades of primary school Greek children use phonological strategies with resulting phonological errors in reading and spelling of more complex words (Porpodas, 1990). In forming this hypothesis the notion of a strategy is conceived as Marsh et al. (1980) define it as an "active change in

processing modes to accommodate task demands" (p. 340). This hypothesis leads to two questions. Firstly, do Greek children use a sequential strategy in the first stages of their reading development, and if they do so is this strategy efficient for reading all words? The second question follows from the first: If a sequential strategy is not sufficient for reading a word do they use other, more complex strategies and for which words? A possible alternative hypothesis is that Greek children master both linear and complex strategies right from the beginning and these strategies can be detected by using different experimental paradigms.

Conditional rules are very difficult for children to learn (Goswami and Bryant, 1990; Marsh et al., 1981). According to Marsh et al. (1981) conditional rules are learned quite late in children's development. Do children learn these complex spelling patterns by rule or by analogy? Analogy is a strategy that is used at some levels of reading although a controversy exists concerning the time of this use (Gombert, Bryant and Warrick, 1997). On the one hand, some researchers argue that analogy is an advanced kind of reasoning and consequently is a late development (Marsh et al., 1981). On the other hand, other researchers suggest that the strategy of analogy can be used quite early (Goswami, 1992; Goswami and Bryant, 1990). In the second case, however, in order to use analogy children must have some decoding skills. Although analogy is proposed to be a useful strategy for English it is of no use in languages with transparent orthographies such as Spanish (Gombert et al., 1997). In Greek there are spelling patterns that involve complex orthographic rules. Do Greek children use analogy for learning these rules and at what age?

II. When do children use contextual cues in reading?

Segmentation strategies enable children to read words that can be characterised as phonologically regular. However, phonological awareness is not an all or nothing process. It develops over time and as children are exposed more to

reading and spelling (Goswami and Bryant, 1990). What do children do when they have to read words which require decoding skills that surpass the ones available to them? Do they fail to read these words? There are suggestions in the literature that children overcome these difficulties by using contextual cues (Tunmer et al., 1994; Stanovich, 1986). Studies of the relationship between children's language prediction abilities and reading indicate that this relationship may vary for the same subject across time and also across subjects. Tunmer and colleagues (1994) hypothesise that the linguistic context is most useful for non-expert readers (beginning and backward readers) who guess rather than read the word and might not recognise it on its own: expert readers rely less on the linguistic context for word identification. It may be a strategy that plays a lesser part in reading as children become better readers.

Greek language has constant or variable but predictable relations between graphemes and phonemes and there is not a class of irregular words, according to Treiman's argument (Treiman, 1993). All Greek words can be read by the application of phonological rules either simple or hierarchical. The existence of both simple and complex phonological rules which allows a differentiation between Greek words leads to the question of whether Greek children use contextual cues when they are reading and for which words. It might be the case that at the beginning of their development, before they master the more complex phonological strategies, Greek children use contextual cues as a strategy to overcome incomplete graphophonemic information.

III. Morphological strategies in spelling

In many alphabetic scripts literacy acquisition is assumed to be a process which develops over time. The outcome of this developmental process is the skilled reader. Some theoretical models propose that skilled readers read words through independent sublexical and lexical routes. The sub-lexical route of word

recognition operates by translating the word's graphemic code on the basis of grapheme phoneme correspondence rules. Recent research on children's reading and spelling has focused on the development of this route and has shown that the acquisition of the sublexical route depends on children's phonological awareness (Bryant & Bradley, 1983; Goswami & Bryant, 1990). It has been shown that this route does not operate only on the level of single phonemes or letters but it involves different levels of phonological analysis such as rimes and syllables (Bryant et al., 1989; Aidinis & Nunes, 1997; Hoein et al., 1995). The lexical processing route involves recognition of words by a direct mapping of a word's visual characteristics onto a stored lexical representation. Recent research indicates that this route does not operate only at the level of whole words but it involves also smaller units such as morphemes (Taft, 1991; Caramazza et al., 1988, Morton, 1982). Although there is much evidence for the use of lexical route in adult reading, little is known of how children acquire this route. Do children simply learn whole words? Do they segment words into morphemes? A lexical route operating at the level of morphemes allows for the reading or spelling of novel words (morphemes from known words can be used for the reading or spelling of unknown words) whereas a lexical route operating with whole words does not allow for the reading of novel words (each word must have its own lexical representation acquired through past experience in order to be recognised) (Caramazza et al., 1988).

Phonological awareness is undoubtedly an important skill for the first stages of literacy development (Bryant et al., 1989; Goswami and Bryant, 1990; Porpodas, 1989, 1993; Aidinis and Nunes, 1997). It is during these stages that children learn how to decode words into smaller units, such as syllables, onset-rime or phonemes, and they understand that letters represent sounds and eventually the way that the alphabet works. As children go on to more advanced stages and grasp more sophisticated principles of reading and spelling, phonological awareness although important is not enough. It is during these stages that another

kind of awareness, namely morphological awareness, becomes important. One important question to consider in order to understand literacy development is whether children learn phonology first and morphology later.

Evidence from the work of Read (1986) and Treiman (1993) on children's invented spelling allows us to conclude that children, at least at the beginning, tend to represent the sounds of the words phonetically. In spelling, as in everything that we have to learn, it is reasonable to start learning the basics first and later on to use more complex strategies. Nunes, Bryant and Bindman (1997) have shown that in English the use of morphological strategies is observed later than phonological strategies and shows a developmental progression, which is predicted by children's morpho-syntactic awareness.

An important hypothesis for the Greek language is that it is necessary to use morphological strategies in spelling: some endings of words which have the same sound will differ in their spelling as a function of their grammatical category. The use of morphological strategies in reading, although plausible, is difficult to test because of the transparency of orthography. However, the use of morphological strategies in spelling can be easily tested because there are plenty of morphological markers. To make this point, conditional rules that are related to grammar in a broad sense, including morphology and syntax (Chomsky and Halle, 1968) can be considered: for example, the last phonemes in plural masculine and singular feminine nouns and adjectives sound the same /i/ but are spelled differently as "οι" and "η" respectively. The last letter(s) of the word can indicate the category (whether it is a verb or a noun), the gender (for a noun or an adjective), the number (whether the word is singular or plural), or the voice (for verbs). Spelling these words using only phonological strategies could result in a number of errors since the same phoneme can be spelled with a number of different letters and there is no differentiation of the spelling in phonology. In contrast, the application of phonological rules will result in correct reading.

Morphological awareness seems to be essential for the correct spelling of these words since these spelling patterns are based on grammar.

Because morphology has been found to be important for the development of spelling in English and there are a lot of morphological markers in Greek, a first question to be asked is whether Greek children use morphological spelling strategies. Moreover, if they do use morphological strategies in spelling do they attend to them from the start or as their English counterparts tend to spell phonologically at the beginning and later morphologically? Is there a developmental model in the acquisition of morphology? A very useful way to answer these questions is to look specifically at particular spelling patterns, and to see when and how children learn them.

Not only suffixes but also stems are important for correct spelling. For example the words produce, producer, product, production, productivity, share the same stem which is spelled consistently while they have different suffixes. Is the consistency of stems easier than the consistency of suffixes? In Greek for many phonemes there are alternative correct spellings and there is no indication of the correct spelling of these phonemes in the stem either in phonology or in grammar. The only indication that children can use in their spelling is the consistency of the stem. As Bryant, Nunes and Aidinis (1998) argue "it is an advantage in understanding connections between words with the same stem over a strategy of treating such spellings as irregular and attempting to learn them all in a rote fashion" (p. 10).

So far in this chapter the role of morphology has only been considered in relation to spelling. However, there is a strong relation between morphology and meaning as well. To make this point the role of prefixes can be examined: for example, "re" is a derivational morpheme that can be added in front of almost any verb or its derivative adding to the meaning of the verb senses such as "once

more", "afresh", "anew", "back", "with return to previous state" (e.g. turn-return, new-renew). Do children understand the different meaning that prefixes add to the words?

IV. The organisation of the thesis

In the first chapter the evidence for the existence of a developmental sequence in the acquisition of reading and writing and the processes that promote development are examined. The major question to be answered in this chapter is whether a sequence from simple to complex rules exists in literacy acquisition. The specific characteristics of the Greek language are also considered in order to develop predictions from this model for reading and writing in Greek. The main focus is on recent studies which have investigated the connection between different sorts of metalinguistic awareness and children's progress in reading and spelling and the strategies that children use in reading and spelling.

In Chapter 2, the hypothesis that Greek children develop their reading skill according to a stage model from simple to complex rules is examined. A second hypothesis that is tested in this chapter is whether Greek children use a sequential decoding strategy when they are reading right from the first year of schooling and if this strategy is sufficient for reading words involving different spelling patterns. The questions which arise from this experiment are whether something more than a sequential strategy is used by children in order to read words for which a sequential strategy is not enough and which these strategies are. These issues are examined in the studies subsequently presented.

In Chapter 3, a second study is presented. In this study, the hypothesis that children make inferences or analogies from the pronunciation of known words in order to read difficult or unknown words (e.g. words that involve conditional rules) was tested.

Chapter 4 describes an experiment designed to test the hypothesis that use of context depends both on the reading ability of the reader and the difficulty of the word.

In Chapters 5, 6 and 7 three studies concerning morphological spelling strategies and their relation with morphological awareness are presented. The hypothesis that children master phonological strategies before mastering more complex morphological strategies was tested. The importance of the consistency of the stems as well as children's understanding of the different meaning that prefixes assign to the words is also examined in these chapters. The use of morphological spelling strategies amongst children attending Years 2 through 5 in school was investigated using a battery of spelling and morphological awareness tests.

In the final chapter, an attempt is made to summarise the major findings of this thesis and to relate them to current theories. Children start reading by using simple phonological strategies before they use more complex ones. Phonological awareness, although important throughout literacy development, is more vital in the earlier stages, and is not sufficient in the later stages. Children have and do find other than phonological strategies but they use them only for the reading of more difficult words. In spelling there is a developmental sequence in the acquisition of the phonetic and morphological spelling strategies. Although the alphabetic principle is crucial for the acquisition of the morphological strategy, children's morphosyntactic awareness also plays a major role. Lastly educational implications and implications for future research are discussed in this final chapter.

CHAPTER 1
PROCESSES INVOLVED IN THE DEVELOPMENT OF READING AND SPELLING

Literacy acquisition is a highly demanding task that requires the participation of more than one sort of metalinguistic awareness (e.g. phonological awareness, morphological awareness and awareness of grammar). Although the relation between metalinguistic awareness and literacy development may be similar in many alphabetic scripts, the significance of the sort of metalinguistic analysis might be related to specific characteristics of the language. In this chapter the developmental sequence and the processes involved in the acquisition of reading and spelling are examined. The idea that children develop literacy in a sequence starting with simple and moving on to complex rules is examined through the analysis of existing evidence in different languages. The processes that promote this development and the strategies that children use in different stages of their development are also considered.

Different theories regarding the development of reading and spelling in English have been proposed (see, for example Marsh, Friedman, Welsh and Desberg, 1981; Frith, 1985). In spite of differences in the explanations for why children progress and in the conception of whether progress is qualitative or quantitative, these theories have made the implicit assumption that literacy acquisition is similar in all alphabetic scripts. However, it may be necessary to test this assumption. Morais (1995) argues that now "everybody admits that it is important to check how and to what extent the orthographic peculiarities of alphabetic languages influence the course of development" (p. 1).

English orthography has been characterised as complex and highly irregular (Treiman, 1993). It involves three kinds of grapheme - phoneme patterns:

invariant, variant-predictable, and variant-unpredictable (Venezky, 1995). The English writing system contains a large number of variant-unpredictable spelling patterns. In other words the large number of exceptions to the rules contributes to the poor fit between graphemes and phonemes in it. In contrast, there are languages such as Italian, German, and Greek that present a much higher degree of constant relations between graphemes and phonemes. Although these are all alphabetic scripts, it might be easier to learn to read in the latter languages and the acquisition progress might differ.

Developmental and structural models of literacy acquisition are considered in the first two sections of this chapter in order to provide a theoretical framework on which some hypotheses for the development of literacy in Greek can be based. Characteristics of the Greek language which might influence the development of reading and spelling are presented in the next section. Evidence that children start reading and spelling by using simple phonological strategies before they use more complex ones is reviewed in the next section in order to see whether a developmental sequence from simple to complex still holds for literacy development in Greek. Children's ability to make inferences (also known as the strategy of analogy) from the pronunciation of known words in order to pronounce unknown words is examined in relation to the hypothesis that the use of this strategy depends on the difficulty of the word and is improved with age. In the following section studies for the use of contextual cues in reading are reviewed in order to provide possible answers to the hypothesis that the use of context to improve accuracy in reading depends both on the skill of the reader and on the difficulty of the word. Following this, the development of morphological strategies in spelling is considered. In Greek, as in many other languages, the application of a phonological strategy alone cannot result in correct spelling because there are spelling patterns the spelling which are determined by morphology in a way that cannot be reduced to phonology. In the

last section some conclusions are discussed and some questions about the development of reading and spelling in Greek are asked.

1.I. Theories of Literacy Acquisition

There are both structural and developmental models for literacy acquisition. Structural models of skilled reading, although helpful, consider only the "outcome" of the developmental sequence. As Frith (1985) argues "a developmental model has certain requirements that are not met by a structural model of skilled reading. Above all, it needs to explain how the various strategies that are mastered by the skilled reader come into being" (p. 301). A developmental model can be understood as sequence of steps. A step forward in the developmental sequence is meant to be the adoption of a new strategy. Viewed in this way reading can be conceived as a developmental sequence of steps with different strategies acquired at different points in the sequence. Structural models of skilled reading, however, can be useful when considering developmental models since a skilled reader has already acquired all the strategies needed for reading.

1.I.a. Developmental models of literacy acquisition

A basic idea in developmental theories of literacy acquisition is that different classes of words involve diverse sources of difficulties in word reading. The classes of words are constituted in such a way that different underlying strategies are expected to be required from the reader to get the words right. One word class, for example, is made up of words that can be read on the basis of a sequential strategy that (a) treats each letter as representing a phoneme; (b) assumes that each letter has just one phonemic value (usually the most common

one); and (c) there is no need to look ahead to identify the phoneme represented by a letter. Words like "word", "cat", "is", "relevant", "poverty" are examples of this category. A second word class is composed of words where the sequential strategy is still basically sufficient for reading but some concessions are made with respect to the one-to-one correspondence principle to encompass the reading of digraphs and double consonants with a fixed pronunciation but maintaining the idea that each grapheme rather than each letter has a fixed pronunciation. Words like "hill", "week", "telephone", "glass", "three", "shed" etc. are examples of this second category. Together they constitute the so called regular words, in which each grapheme represents a phoneme with its preferred pronunciation. Venezky (1995) has characterised these words as involving invariant orthographic patterns. Although theories developed for English do not as a rule distinguish between these two initial classes and tend to treat all regular words as a single class, it is possible that they differ in the difficulty they pose to children, at least when they start to learn to read.

Another word class is constituted by words that contain variant but predictable spelling patterns (Venezky, 1995), also known as conditional or hierarchical rules. In order to read these words it is necessary to look at what comes later in order to know how to pronounce what comes earlier on in the word. Although conditional rules may appear rather simple, they have been shown by Marsh et al. (1981) to cause difficulties for children. An example is the rule known amongst teachers as "the magic E", that relates to the short/long vowel contrast (such as in -at and -ate, for example). To sort out this contrast, all the child needs to do is to check whether there is an E at the end of the word to figure out the pronunciation of the A. Other conditional rules studied by Marsh et al. were the pronunciation of G and C as a function of the vowel that follows these consonants.

Conditional rules do not make the reading of the word unpredictable but simply

require a different, non-sequential strategy. There is, however, a further class of words in English where the pronunciation is not totally predictable from the spelling, the class of irregular words or the words that involve variable unpredictable spelling patterns (Venezky, 1995). This unpredictability may result, for example, from the fact that a grapheme may have different pronunciations which cannot be chosen on a rule-based fashion (for example, OW has different pronunciations in "know" and "now", CH is pronounced differently in "chemistry" and "cherish") or from the fact that certain words are simply considered exceptions (for example, the magic E does not work in "have" or "love").

1.I.a.i. Marsh's cognitive-developmental theory of reading acquisition

Marsh, Friedman, Welch and Desberg (1981) proposed a four stage theory for reading development. According to their claim, at each stage of development the reader has particular intellectual skills that change as s/he grows up. These intellectual skills are highly associated with the stage of intellectual development that the reader is at. The four stages that Marsh et al. propose are:

Stage 1 - Linguistic Guessing. At the onset of reading acquisition children learn "rote associations between an unsynthesized visual stimulus and an analysed oral response" (Marsh et al., 1981, p.201). In this stage the child is not able to use the phonological code in order to decode words. The strategies available to children are rote learning and linguistic guessing. Children are unable to read unknown words in isolation. When reading an unknown word in context children substitute the unknown word with a syntactically and semantically appropriate word without paying any attention to the graphic features of that unfamiliar word.

Stage 2. Discrimination Net Guessing. In this stage the child begins to pay

attention to graphemic features of words and also to use context and linguistic cues to help him read. The strategies that children use in this stage are rote learning, guessing based on visual cues and guessing based on visual and linguistic cues. The graphemic features that children use are limited to the first letter at the beginning; later on additional features such as word length, final letter etc. are processed.

Stage 3. Sequential Decoding. Entering this stage of reading development coincides with entering the stage that Piaget called concrete operations (at about the age of eight years). The new strategy that children acquire in this stage is decoding from left to right. There are two major factors involved in the development of this strategy. The first one is environmental and has to do with the increase in the number of printed items that the child encounters. As the print vocabulary grows it places a greater load on the child's memory. The second factor is cognitive and is related to the ability that children have to master quite complex rules when entering the stage of concrete operations. So the child now can attend both to the sounds and to the meaning of a word, s/he can analyse words into phonemes, and s/he can use grapheme-phoneme correspondences to read unfamiliar words. However, only regular words can be decoded at this stage because children are still unable to use higher order hierarchical rules such as the "magic E".

Stage 4. Hierarchical Decoding. In this last stage the child is able to use a decoding strategy using higher order rules. Children are now able to read words that involve conditional rules such as the magic E. It is also at this stage that children can spontaneously use the strategy of analogy in order to read unknown words. As Marsh et al. suggest, because these word patterns require conjunctive, disjunctive and class inclusion rules, the child will typically not enter this stage until the middle years of childhood (after the age of 10 years).

Two experiments were carried out by Marsh et al. in order to provide an empirical foundation for the proposed developmental sequence. In the first experiment 20 second grade and 60 fifth grade children, 40 college students and 15 reading- disabled children were asked to read two passages of the Gray Oral Reading Test. 18 non-words were entered in nouns positions in the story sentences. Four of the non-words were CVC words (e.g. han); another four were long vowel silent e patterns (e.g. hane); three non-words for the vowel shift patterns (e.g. hane, hanity); three for the conditional c-rule (e.g. cim, cime, cimity); and four words for the assessment of the children's use of analogy strategies (e.g. faugh, which is pronounced as faw by a decoding strategy and as faff by analogy to laugh). Children had to read the words both in the passages and in isolation. All the groups differed significantly from each other in performance on the strategies except the second graders and the reading-disabled children. Significant differences between subjects' performance in the various groups of words were also found with older subjects performing better on the long vowel and the conditional c-rule. Only 25% of the responses of the reading-disabled children were classified as substitution strategies. As the authors say, Stage 1 and 2 performance is characteristic of the first year of reading instruction when the instruction is started at 5 or 6 years of age. Normal second graders were predominantly in Stage 3, because they performed very well in the CVC words while they were significant differences between second and fifth graders in the conditional rules. Lastly, fifth graders and college students' performance was classified as Stage 4.

The second experiment was designed to investigate the role of visual familiarity and phonemic regularity in reading. The subjects were 20 second, 21 fourth graders and 24 fourth grade reading-disabled children who were two years below their grade level. The children were asked to read or spell two lists of 20 words. The first list contained 20 high-frequency words half of which were regularly

spelled and the other half were irregularly spelled. The second list contained 20 non-words which were produced by transforming the 20 real words on the first list. There was significant interaction between word type and age group. Phonemic regularity was a significant factor in both reading and spelling for all grade levels and there was no significant difference in second and fourth graders' performance in words and non-words. Second graders and reading-disabled children showed more stage 2 substitution errors than the fourth graders. Most of the subjects however were in stages three and four as expected.

Marsh's theory has been criticised on the grounds of an absence of discrimination between the different levels of phonological awareness (Goswami and Bryant, 1990). Marsh views phonological awareness as being purely a thorough knowledge of phonemes and grapheme-phoneme correspondences, and ignores larger phonological units such as onsets and rimes which have been shown to be important in the development of reading and spelling in English.

Another criticism that this theory has received is related to the claim that it is the vocabulary growth that causes children to shift to a decoding strategy for reading (Stuart and Coltheart, 1988). Stuart and Coltheart (1988) suggest that it is the development of phonological skills that leads children to use a decoding strategy and not vocabulary growth. There are suggestions in the literature, however, that the phonological strategy develops from bigger to smaller units through reading (Goswami and Bryant, 1990). Hence, it is possible that vocabulary growth help children to develop their phonological skills further at the level of phonemes.

Lastly, Marsh et al.'s theory cannot account for the development of spelling, at least for the first stages, since there is evidence opposing the use of a logographic strategy (Goswami and Bryant, 1990). On the contrary, evidence from children's invented spelling (Read, 1986) suggests that very young children tend to use their

letter sound knowledge in their writing. In languages where the syllabic structure is simpler, young children tend to represent whole syllables in their writing (Ferreiro and Teberoski, 1983). This criticism is answered by Marsh et al. (1980), when they admit that "except for the substitution strategies, there is considerable congruence in the development of strategies in reading and in spelling" (p.351). According to this suggestion, children start writing by using a phonological strategy that enables them to spell words that involve simple grapheme-phoneme correspondence rules. Later, they develop a hierarchical decoding strategy and in the end they develop a strategy of spelling unknown words by analogy to known words.

1.I.a.ii. Frith's theory of reading acquisition

Frith (1985) modified Marsh's theory of reading development in order to provide links with models of skilled reading. She generated a three phases - six steps model of literacy development with each phase identified by the strategies that the child uses. She called these three strategies "logographic, "alphabetic" and "orthographic" and she hypothesised that they follow each other in strict sequential order.

Phase 1. The first phase of reading acquisition according to Frith's model involves a logographic strategy. Children can instantly recognise familiar words probably by using salient graphic features. The first phase is divided into two steps indicating that there is a differentiation in terms of the level of skill in a particular strategy. A dissociation between reading and writing also exists and Frith argues that it is only when the logographic strategy has reached the second more advanced level that it can be used for writing. This phase covers the two first stages of Marsh's theory for reading development where the predominant strategy is rote learning.

Phase 2. The alphabetic strategy is acquired in this stage. The child adopts the alphabetic strategy first for writing and later for reading. Hence, in the first step of this phase the child is reading using a logographic strategy (although in an even more advanced level 3 than the level 2 of the first phase) but s/he is writing using a basic level 1 alphabetic strategy. In the second step of this phase the child uses the more advanced level 2 alphabetic strategy for both reading and writing. The child knows and uses grapheme phoneme correspondences; letter order and phonological factors are crucial and the child is able to pronounce unfamiliar and non-words since words are sequentially decoded grapheme by grapheme. The conversion rules for sounds and letters are acquired gradually; first the simple ones and then the more complex, such as the conditional rules. This second phase covers the stages 3 and 4 of Marsh's theory where the strategy of sequential and hierarchical decoding is predominant.

Phase 3. This is the last phase in the development of reading and writing where children shift to an orthographic strategy. As Frith (1985) states "orthographic skills refer to the instant analysis of words into orthographic units without phonological conversion. The orthographic units ideally coincide with morphemes" (p.306). The orthographic strategy replaces the analogy strategy used by Marsh et al. and can be differentiated from the logographic and the alphabetic strategies in the sense that in order to form these larger units (morphemes) in the orthographic strategy, the child has to synthesise phonemic elements into meaningful units. Therefore, the child has to pass through an alphabetic phase in order to be able to recognise the phonemic elements. Moreover, a further distinction between the orthographic and the logographic strategies is that the orthographic strategy is analytic in a systematic way and it is non-visual. Again a differential exists between reading and writing since in the first step of this phase the child is using a level 1 orthographic strategy for reading and an advanced level 3 alphabetic strategy for writing. In the second

step of this phase an advanced level 2 orthographic strategy is used for both reading and writing.

Frith's evidence for her proposed model of reading development come from other people's research and Stuart and Coltheart (1988) argued that sometimes this evidence is questionable. As an example they referred to the evidence for the logographic strategy which is based on a review paper by Torrey (1979). In this paper, which examined seven studies of early readers, it was found that these children performed relatively highly in tests investigating knowledge of letters. It was also noted from interviews with the parents that they had taught them letter-sound correspondences.

Frith's model suggests that there are causal links between reading and spelling. Experiences with reading influence children's spelling and experiences with spelling influence children's reading. However, there is no reference in this model to how phonological skills that are acquired before children learn to read influence their reading and spelling (Goswami and Bryant, 1990). Furthermore, Frith, similarly to Marsh, suggests that the first phase of writing is dominated by the use of a logographic strategy, although at an advanced level, while there is evidence that this is not the case (Read, 1986; Ferreiro and Teberoski; 1983; Treiman, 1993).

Both Marsh's (1981) and Frith's (1985) theories of literacy development are based on evidence from the English language. Can these theories account for literacy development in other languages? Marsh et al. (1980) argue that "the sequence of strategies of reading and spelling is therefore not necessarily seen as universal and invariant, although there may be an invariant sequence of basic cognitive processing strategies as proposed by Piaget and others" (p. 340). Marsh's statement allows for an alternative hypothesis that specific features of

the orthography may influence the literacy development.

1.I.b. Structural Models of Literacy Acquisition

A very influential structural model for literacy acquisition is the model proposed by Morton and Patterson (Murell and Morton, 1974; Morton and Patterson, 1980; Morton, 1980; Morton, 1982; Patterson and Morton, 1985;) known as the dual route model. According to this theory, which is based exclusively on skilled reading, there are two types of processes involved in reading. Words can be read either via a direct lexical route or via an indirect sublexical route that involves phonological analysis and letter-sound relationships.

Research on adult skilled reading, including naming and lexical decision tasks, suggests that fluent readers use the direct lexical route when they are reading and the indirect sublexical route is used as a back-up strategy in the reading of unfamiliar words or pseudowords. Evidence for the existence of the two routes also comes from studies of dyslexic readers which have shown that dyslexia is associated with both phonological (Rack, Snowling and Olson, 1992) and visual (Goulandris and Snowling, 1991) deficits. According to the dual route model the sublexical route is of limited use because there are words that cannot be read or spelled by the application of phonological rules. In the original version of the model (Morton and Patterson, 1980) the sublexical route involved analysis at the level of phonemes and the lexical route involved whole words. Children right from the beginning of their literacy acquisition have two possible processes in learning the words: either as wholes or by applying grapheme - phoneme correspondence rules.

Research on beginning reading is inconclusive about whether children at the beginning of literacy acquisition use a phonological strategy and then start to use

a visual strategy (Bryant and Bradley, 1983; Goswami and Bryant, 1990) or whether they start by using a direct visual strategy and later develop a phonological strategy (Marsh, Freidman, Welch and Desberg, 1981; Frith, 1985). Theorists in favour of the second view claim that children, like skilled readers, use the lexical route and later develop the sublexical route which is used as a backup strategy (Goodman, 1967; Smith, 1979); theorists in favour of the first view claim that children start by using the sublexical route and later develop the lexical route (for a review see Goswami and Bryant, 1990).

There is rich evidence for the use of the sublexical route by children at the beginning of their literacy acquisition. Recent studies on literacy development have demonstrated that phonological awareness plays a major role in learning to read and spell (see Goswami and Bryant, 1990). In these studies it has been shown that the sublexical route does not operate only at the level of phonemes but it involves bigger phonological units such as onset - rime and syllables (see Aidinis and Nunes, 1997). Patterson and Morton (1985) have expanded the sublexical route of the dual route model so that the assembly of a phonological representation is not limited to orthographic units that map onto phonemes. According to this revised model the sublexical route employs an orthography to phonology system that uses larger orthographic units called bodies (e.g. rime) as well as small orthographic units (i.e. graphemes).

Although the sublexical route for literacy acquisition is well documented, little is known about the acquisition of the lexical route by children. Research on adult reading has shown that this route does not operate on the level of whole words but it involves smaller units such as morphemes (Taft and Zhu, 1995). The importance of the difference between a lexical route operating on the level of words and one that operates on the level of units smaller than whole words lies in the assumption that the latter allows for reading of novel words while the former

does not (Nunes and Bryant, 1997). A lexical route operating on the whole word level implies that each word has its own representation and that it has been acquired through past experience. Consequently, a novel word that has not been seen before cannot possibly be read because there is no representation of this word in the lexicon. Lexical access based on morphemes would allow the processing of a novel word such as "fetched" assuming that the subject has a lexical representation of "fetch" (the stem) and "ed" (the inflectional morpheme for past tense) (Caramazza et al., 1988).

The role of morphemes in adult reading has been documented in a variety of languages including English (Fowler & Liberman, 1995; Kelliher & Henderson, 1990; Morton, 1982; Murrel & Morton, 1974; Taft, 1985; 1991), Danish (Elbro, 1990), Italian (Caramazza, Laudana and Romani, 1988) and Hebrew (Bentin & Frost, 1995). Murrel and Morton (1974), for example, found that words were recognised more accurately when the subjects were pretrained with words that shared the same root morpheme with the target words than when they were pretrained with words that resemble the target words in visual-acoustic features.

More recently, Taft (1991) proposed a multi-level model of processing in reading according to which different orthographic units are visually processed, ranging from single letters to whole words passing through other units smaller than a word such as syllables and morphemes. Much of the evidence for this model comes from lexical decision tasks, where subjects are asked to decide whether a visually presented string of letters is a word or not. Morphological effects are demonstrated in that the decision takes significantly longer when real morphemes are components of the pseudo-words than when the letter strings do not contain real morphemes.

These observations suggest that, when real morphemes are identified, the subjects

still need to consider whether, when put together, the morphemes form a word or not. Stimuli containing units which do not coincide with any morpheme can be rejected more quickly because they do not coincide with units of processing. The lexical decision is also influenced by the violation of grammatical relationships between morphemes in pseudo-words.

Caramazza, Laudana and Romani (1988), presented Italian adults with two types of stimuli. In one type of stimulus, the letter string was composed of a real stem and a real inflectional morpheme in a plausible grammatical combination (the correct inflection for the type of verb that the pseudo-word could have been); in the second type, the stimulus contained a real stem and inflectional morpheme but the combination was not appropriate grammatically. Lexical decisions took significantly longer when the combination was grammatically plausible than when it was not, suggesting that the grammatical violation abbreviated the decision process, although both types of stimuli only contained real morphemes.

The use of a phonological strategy in reading and spelling could result in correct reading and spelling of regular words but it would be of little use for irregular words that involve variant - unpredictable spelling patterns. This is the major reason for the existence of the lexical route. Because there is no possible way of reading or spelling these words by the application of grapheme - phoneme correspondence rules they must be acquired by rote learning. Taft (1991) argues that "information about the correct pronunciation of an irregular word can only be determined from information stored within its lexical entry, and therefore, only a direct visual route to the lexicon can be used in recognising irregular words" (p. 74). This might be true for the English language. Then, the argument goes, if we had a transparent orthography with constant grapheme - phoneme relations, the sublexical route would be able to account for the reading and spelling of every word in this language. A single route model would be more

appropriate in describing the processes involved in reading and spelling in such languages.

The dual route model of literacy acquisition has been criticised as incomplete in explaining the processes of reading acquisition in the first stages (Barron, 1986). This criticism focuses on the assumption that, when children begin to read, they can use only one procedure for accessing word meaning - either via a direct lexical route or via an indirect phonological route - and they acquire a second independent procedure as they develop their reading skill. Humphreys and Evett (1985) in an evaluation of the dual route model came to the conclusion that "there is no sound empirical basis for the existence of independent lexical and non-lexical route" (p. 690). They proposed an alternative view that lexical knowledge can guide the assembly of phonological information.

Barron (1986) took this assumption further in proposing a single process lexical model in which acquisition and performance of word recognition can be accounted for by interactions among orthographic and phonological units of various sizes in the lexicon. According to this model learning to read words entails the acquisition of an orthographic lexicon with multiple levels of interacting units smaller than whole words. Grapheme-phoneme correspondence rules participate in this model by segmenting the letter string into grapheme-phoneme units which are stored as part of the lexical entry of the word. These units can be used on subsequent occasions as part of the process of recognising the word. The role of grapheme-phoneme correspondence rules in this model is to contribute a set of procedures for segmenting, sequencing and retaining one level of orthographic units within an interactive system of developing lexical knowledge. Other procedures might contribute different levels of units (for example, analogies can contribute bodies).

A visual-phonological route in reading has also been proposed by Ehri (1992). According to this model connections that are established between the word's spelling and pronunciation are more useful and less arbitrary than connections that are established between the word's spelling and its meaning. The former connections which are visual-phonological ones help the reader to recall the word faster because the connections are between letters and sounds. The difference between reading by phonological recoding and by visual-phonological connections is that once the visual-phonological connections have been established there is no need of phonological recoding the words again because the connections have been stored in memory as images of the words amalgamated with their meaning. However, recoding ability is essential in establishing these connections and children with poor recoding skills are the less skilled readers.

Ehri defines three phases in the development of sight word reading. Each phase is defined by the kind of connections that are formed between visual cues seen in print and information about a specific word stored in memory. The first phase is the logographic phase or visual cue reading. The connections that are formed during this phase are between spelling and meaning. These connections, as Ehri argues, are arbitrary and easily forgotten unless they are frequently practised. These visual connections are not specific to individual words and children can mistake visually similar words. The second phase is the rudimentary alphabetic phase or phonetic cue reading. During this phase children start to use their knowledge of letter-names and sounds to form systematic connections between the letters of the words and sounds detected in their pronunciations. Visual-phonological connections in this phase are incomplete and they are confined only to some letters of the word usually the first and the last. The last phase is the mature alphabetic phase or cipher reading. Readers in this phase use their complete phonemic segmentation and phonological recoding skills to form complete visual-phonological connections between all the letters of the word and

their corresponding phonemes. The connections are not limited to individual letters but involve sequences of letters or digraphs.

Rack, Hulme Snowling and Wightman (1994) tested the hypothesis that young children associate visual cues with spoken words. They presented reception and year 1 children with word cues in which all but one of the letters corresponded to phonemes in the spoken word. Some of the cues were phonetic where the exception letter in the cue corresponded to a phoneme that was articulate similarly (for example, bzn for basin) and some other were control where the exception letter did not articulated similarly (for example, bfn for basin). They found that children found the phonetic cues easier to learn than the control ones. A similar view that the logographic stage of reading development is not purely visual but it also involves phonological cues was found by Stuart and Coltheart (1988).

Greek has a transparent orthography and all the words can be read with the application of phonological rules whether simple or hierarchical. A single route model (either sublexical or visual-phonological) that involves phonological cues seems to be sufficient for explaining reading acquisition in Greek. A lexical route operating at the level of morphemes may be of little use for reading. This is because the predictability of pronunciation from print suggests that morphology may play a minimal role in reading although correct spelling might be a different matter.

Reading Greek is highly dependent on grapheme - phoneme correspondences but spelling is not predictable just on the basis of phoneme - grapheme correspondence. Spelling depends on morphology but even morphology does not specify spelling completely. For example the phoneme /i/ can be spelled in five different ways (as ι, η,

υ, οι, ει)[1] . When it is a suffix, it has a fixed spelling: for example "ι" is used with neuter nouns, "η" for feminine nouns and adjectives, "οι" masculine plural nouns and adjectives and "ει" for third person singular active verbs in one conjugation. The phoneme /i/ in a stem can take any of the five letters. Lexical information can be used in spelling (for example "ναυαγώ" (be wrecked) and "ναυαγός" (shipwrecked person) share the same stem). Yet, for the reasons that I have just given, it is quite impossible to spell Greek words just on the basis of a thorough knowledge of letter-sound relationships. One needs to use morphological strategies in spelling as well as phonological strategies.

Although there is evidence from diverse languages regarding the use of morphemes by adults in reading, little is known about children's use of morphemes in reading and spelling. It is only in recent years that new studies have shown how important it is for children to understand the connection between grammar and spelling in a variety of scripts but also that this acquisition is not simple and happens over an extended period of time. These studies also reveal that children learn about the connection between grammar and spelling in strikingly similar ways across different languages.

1.II. Reading acquisition in different languages

1.II.a. The influence of the transparency of the language on literacy acquisition

Wimmer and Goswami (1994) proposed that there are two kinds of effects of the orthography on reading and spelling: a direct effect and an indirect effect. The direct effect is attributed to the transparency of the orthography, for example constant relations between graphemes and phonemes. The indirect effect is also

[1] A sixth possible spelling of the phoneme /i/ exists the digraph "υι" but is very rare and appears only in a few words.

connected to the transparency of the orthography in terms of influencing the teaching methods that are used which indirectly can influence literacy development. For example, a phonics approach could be a very good strategy for a highly transparent orthography while it might not be equally adequate for a less transparent one. Along similar lines Seymour and Evans (1994) in studying different levels of phonological awareness argued that "it is inappropriate to formulate theories of the relationship between PA (phonological awareness) and literacy in universal terms. The instructional approach which is adopted is probably critical. Hence, the developmental theories are more properly seen as accounts of the impact of instruction" (p. 243).

Research in different languages which use alphabetic scripts has shown that specific characteristics of the language might influence the course of literacy development (Wimmer and Hummer, 1990; Wimmer and Goswami, 1994; Porpodas, Pantelis and Hatziou, 1990). Wimmer and Hummer (1990), for example, examined whether first grade Austrian German-speaking children use logographic or alphabetic strategies in the first stages of their reading and spelling development. A logographic strategy implies a number of substitutions of non-words with real words (logograhic or visual errors) or no reading attempt of non-words. On the contrary, an alphabetic strategy implies quite infrequent reading refusals because each letter can be sounded out and quite frequent non-word responses since recoding errors lead to incomplete or erroneous pronunciations that do not correspond to any existing word (phonological errors). Children were divided into two groups, a normal and a reading/writing delayed group. Tasks included standardised tests of reading and spelling, a test of grapheme knowledge, a word and pseudoword reading task and a word and pseudoword spelling task. If children use an alphabetic strategy in their reading and spelling then they should read both words and non-words similarly and their errors should be phonological.

There was a significant difference in children's reading between words and pseudowords but their errors were predominantly phonological indicating the use of an alphabetic strategy. This was true for both normal and delayed children. However, in spelling there were more traces of the use of a logographic strategy by the delayed children since they spelled phonologically correct or partially correct only 70% of the words and pseudowords compared to almost 100% correct or partially correct spellings in the normal group. Based on these results and on previous studies for German pre-schoolers, the authors concluded that for German-speaking children the logographic strategy is of limited importance. The lack of a logographic strategy in the first stages of literacy development for German speaking children was attributed to the phonetic transparency of the German language. Another explanation of this finding might be that Austrian children are exposed to reading and spelling at the age of seven compared with the British and American children who start literacy instruction at ages of four and five.

An attempt to provide a more direct test of the assumption that the transparency of the orthography influences literacy development was made by Wimmer and Goswami (1994). Wimmer and Goswami, comparing English-speaking and German-speaking children, tested the hypothesis that there is a difference between these two group of children in terms of the strategies that they use in the first stages of literacy development. Their hypothesis was based on the greater consistency of the German orthography - in terms of grapheme phoneme correspondences - as compared to English orthography. They gave 153 seven, eight and nine year old English and Austrian children a numeral reading task, a number word reading task and a non-word reading task. Their prediction was that there would be a difference in the non-word reading task because the German-speaking children were used to assembling pronunciations.

Wimmer and Goswami found a significant difference between English and German speaking children in the errors for non-word reading for all the age-groups. This result indicates a difference in the strategies that the two groups of children use. This conclusion was strengthened even more when the errors made by the children in the two different languages were examined. There were 37 cases where English children refused to read a non-word while even the younger Austrian children never refused to read a non-word. The conclusion of the authors was that "it is the nature of the orthography that determines initial differences in reading strategy, and the nature of the task that ensures eventual convergence towards direct access" (p. 102).

Working with Greek children, Porpodas, Pantelis and Hantziou (1990) examined whether first grade children read and spell using a logographic or an alphabetic strategy. They tested 40 six to seven year old children in three different reading tasks: in the first task half the words were nouns and the other half were adverbs, conjunctions and prepositions; in the second task half the words were high imageable and the other half low imageable; and in the third task half the items were words and the other half were non-words, which were created by changing two or three letters of the real word, equally divided between homophonic and non-homophonic to real words. All the words were controlled for frequency and length.

There was no significant effect of frequency in any of the three tasks. Also there was no significant difference either between the words belonging to different grammatical classes or between the words of high or low imageability. Similarly, there was no significant difference between words and non-words in the third task but there was a significant regularity effect on all but the second task. These results indicate the use of an alphabetic strategy by Greek children even at the beginning stages of literacy development (children in this study had been at

school for only six months). The existence of many visual errors in children's reading, however, indicates that they might use a visual strategy as well. The authors conclude that these children might be in a transition stage by starting to adopt a visual strategy in addition to the phonological strategy they already employed.

Using a sample of older children, Porpodas (1990) obtained results similar to those described above. The participants in this study were 36 fourth grade children (equally divided into three groups (good readers - good spellers, good readers - poor spellers, poor readers - poor spellers). Children had to read and spell a list of 24 words and 24 non-words derived from the words. Half the words were regular and the other half were involving variable but predictable spelling patterns (the authors called them exceptions) with controls for frequency, word length, consonant complexity and grammatical class.

No significant differences in reading regular and words that involve variant spelling patterns were found for any of the groups except the poor readers - poor spellers. Reading non-words was not more difficult than reading words for the good readers - good spellers while it was significantly more difficult for the other two groups of children. For spelling, significant differences between regular and words which involve variant but predictable spelling patterns were found for all the groups of children. In spelling non-words children made significantly fewer errors than in spelling words. These results show that Greek children even at the fourth grade (nine years of age) predominantly use a phonological strategy both in their reading and spelling. The author concludes that these results does not rule out the possibility that better readers use a visual strategy, especially in reading, since both regular and words that involve variant but predictable spelling patterns (exception words according to the author) were read correctly by the good readers. However, even this second class of words can be read using a

phonological strategy albeit a more complex one than a simple sequential strategy.

In summary, studies from languages characterised as transparent such as German and Greek, show that children right from the very beginning of their schooling use a phonological strategy in reading. In contrast, English speaking children start by using a logographic strategy in their reading (Marsh et al., 1981; Frith, 1985) although there are indications that this visual strategy has phonological underpinning at least at the level of the onset-rime distinction (Goswami and Bryant, 1990; Hummer and Goswami, 1994). Having in mind the models of reading development presented earlier and the evidence for the influence of the transparency of the orthography on literacy development an attempt to describe reading development in Greek will be made.

1.II.b. Some hypotheses about word reading in Greek based on the models of reading development

1.II.b.i. Word classes in Greek

According to both Marsh's and Frith's theories children acquire the simple rules first (the alphabetic phase) and the more complex one later (the orthographic phase). A major question to be asked in this thesis is whether Greek children develop literacy skills in a similar way. Greek language is very shallow when reading and it can be questioned whether a stage model from simple to complex strategies still holds.

Phonological representation in written Greek is much simpler than in written English. Word reading in Greek is always predictable although not all words could be characterised as depending on simple grapheme - phoneme

correspondence rules. The Greek language involves both simple, invariant letter sound rules and spelling patterns called "variant but predictable" (Venezky, 1995). In order to clarify the distinct word classes in Greek word reading, I will now describe the representation of consonants and vowels.

Three different classes of words can be found in Greek: 1) words that have one-to-one constant relations between graphemes and phonemes; 2) words that have two-to-one constant relations between graphemes and phonemes (those that involve digraphs and double letters); and 3) the words that have one-to-one variable relations between graphemes and phonemes (those that involve conditional rules).

In Greek there is one-to-one correspondence for almost all the consonants but there is a need to distinguish between two classes of regular words. In the first class of words, the correspondence is obtained at the level of letter-sound (e.g. "τραπέζι", (trapεzi), "table"). Most Greek consonantal sounds involve such invariant correspondences between graphemes and phonemes. Some consonantal sounds are represented by digraphs and the particular combinations of letters have a fixed pronunciation (e.g. "**μπ**", /b/ "κα**μπ**άνα", (ka**b**ana) "bell"; "**ντ**" "**ντ**ύνομαι", (**d**inomε), "get dressed"). Although digraphs have fixed pronunciations the "one letter for one sound" rule does not apply in these words.

There are also some words where doubling of the consonant appears such as ("**σσ**" "θάλα**σσ**α" (θalasa), "sea"; "**λλ**" "πο**λλ**ά", (pola), "many"). This doubling of the consonant does not affect its pronunciation but the "one sound for one letter" rule also does not apply in these words and, like those involving digraphs, they will be considered as belonging to the second class of regular words.

A conditional rule involving consonantal sounds also exists. It has to do with the

"αυ-ευ" combinations. There are two difficulties with these combinations: 1) "υ" written on its own is pronounced /i/, a vocalic sound, whereas in these combinations it represents a consonant; and 2) the two combinations are pronounced as af-εf and sometimes are pronounced as av-εv depending on which letter follows this sequence. Children in first grade are taught words in which these two combinations are pronounced differently but they are not taught the rule, which might be taught only in fifth or sixth grade.

Rules for the pronunciation of vowels are more complex in Greek. First, there is a difference between the rules for spelling and reading. A vowel sound may be spelled in different ways; however, one spelling, in the majority of the cases, has only one pronunciation. Second, the consistency in pronunciation is greater at the level of the grapheme than at the level of the letter. For example, the two letters "αι" together represent the sound /ε/ as in "παίζω", (pεzo), "play", but separately "α" represents the sound /a/ and "ι" represents the sound /i/. Thus there is a need to distinguish between the first two classes of regular words on the basis of vowels just as there is for consonants. Third, two conditional rules also exist in the case of vowels in Greek. These conditional rules have to do with vowel digraphs. When the stress mark " ΄ " is on the first letter of a vowel digraph "άι" then the two letters are pronounced separately as /ai/. Similarly when a diacritic mark called dialitika " ¨ " appears on the second letter of the vowel digraph "αϊ" again the two letters are pronounced as /ai/.

1.II.b.ii. The syllabic structure of Greek

Apart from the fact that Greek has a more transparent orthography than English, another difference between Greek and English concerns the linguistic units that may influence children's reading. In contrast to the English language, Greek has very few monosyllabic words, except for function words such as articles, prepositions etc.

(Tombaidis, 1992). It has many two syllable words and a great number of multisyllabic words. The syllabic structure is simple and there are clear rules for syllabification. Thus it is possible that the syllable plays a significant role in word reading as a unit of sublexical analysis. In languages where the syllabic structure is simple, the syllable has been shown to play a significant role in the acquisition of reading and spelling. Ferreiro and Teberoski (1983) have found that Spanish-speaking Argentinean children as young as four and five years old seem to be able to divide words into syllables and use syllables as significant units in spelling. Similar results have been obtained for Portuguese, a language with a simple syllabic structure (Carraher, 1987).

In contrast, there are many monosyllabic words in English and the analysis of a word into syllables is very complex whereas the analysis of onset and rime (which are also sublexical units) is not as difficult. There is evidence that children use rime as a significant linguistic unit in reading (Goswami and Bryant, 1990). In other languages, such as Norwegian and Greek it has been found that syllable is an important linguistic unit in reading (Hoein et al, 1995; Aidinis and Nunes, 1997). The role of syllables in word reading in English is not quite so clear. Perhaps as a consequence of the complexity of the syllabic structure, linguists agree among themselves with respect to the number of syllables in a word but they do not always agree about the location of syllable boundaries in words of more than one syllable (Treiman, 1993). This difficulty may be responsible for the lack of interest among English researchers in the role of syllables in reading acquisition.

Given the greater simplicity of written Greek but the fact that there are still three classes of words requiring different underlying strategies in reading, I expect to be able to replicate the sequence of acquisition observed in English but perhaps at a faster pace. I also expect that children will read regular words of class one with greater ease than those of class two and they will find words that include conditional

rules the most difficult. Lastly, words with complex syllables may be more difficult than words with simple syllables.

1.III. Phonological awareness and simple phonological strategies as the first step in reading acquisition

The vast majority of researchers on literacy acquisition, in recent years, agree that the most important step that a beginning reader has to take is to crack the phonological code and to be able to use it in order to form relations between graphemes and phonemes (Goswami & Bryant, 1990; Rego & Bryant, 1993). Reading by using phonological strategies involves different levels of phonological and orthographic analysis such as phonemes or letters, onset-rime or syllables. Evidence for the use of the phonological code in reading comes from a variety of languages including English.

1.III.a. The connection between phonological awareness and reading acquisition

1.III.a.i Evidence from English

A very influential study for the connection between phonological awareness and reading was carried out by Bradley and Bryant (1983). In order to test the hypothesis that there is a relation between children's phonological awareness and their progress in reading Bradley and Bryant carried out a longitudinal study in which they measured four and five year old children's sensitivity to rhyme and alliteration before they had started to read, and related these measures to their progress in reading and spelling over the next four years. The measure of phonological awareness was the oddity task. In this task the experimenter says three or four words, all but one of which share a common sound. The child has to

detect the odd word out. A measure of verbal intelligence was also included. At the end of the project, after four years, they gave children a reading test, a spelling test and an arithmetic test. A high relation between the children's initial sensitivity to rhyme and alliteration and their progress in reading and spelling more than three years later was observed. These relations remained strong when the influence of intellectual level and the difference in memory were removed. From these results it is clear that there is a strong and specific relation between children's sensitivity to rhyme (alliteration was also predicted children's arithmetic skills) and their later success in reading and spelling. The more sensitive the child is to rhyme the quicker s/he will learn to read.

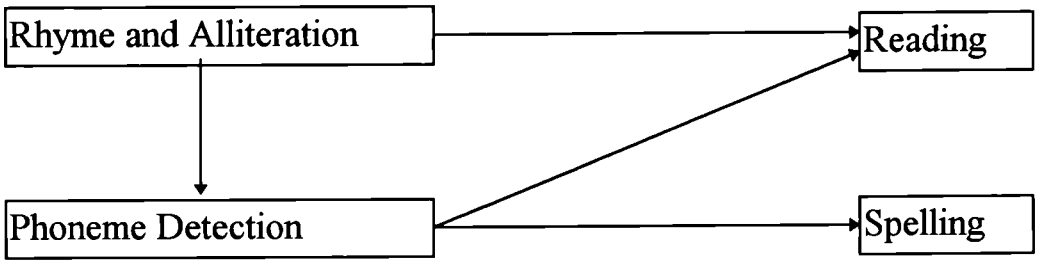
In another longitudinal study Bryant, Bradley, Maclean and Crossland (1989, 1990) and Bryant, Maclean and Bradley (1990) examined what sort of phonological awareness (rhyme and alliteration or phoneme detection) is more important for literacy acquisition. In this study the children (mean age 3;4 at the beginning and 6;7 at the end of the project) received training in a number of tasks. The children were given tests of rhyme and alliteration at different points in the project. They were also given phoneme oddity tests of two types: a phoneme deletion test and a phoneme tapping test.

Children performed quite well in the rhyme oddity tasks even at the age of three years and four months. In contrast both phoneme tasks were very difficult for these very young children and the ability to manipulate phonemes appeared only after children were five years old. Both rhyme and phoneme detection scores predicted reading, even after controls for differences in the children's intelligence, their vocabulary and their social background were included.

Children's rhyme scores were strongly related to their success in the phoneme detection tasks later. Children's ability to detect rhyme predicted their reading

ability even after controlling for differences in the phoneme detection tasks. The relationship between spelling and children's rhyme scores disappeared when controls were made for differences in the phoneme detection tasks.

In the light of the above results, a proposed model for the links between rhyme, phoneme detection and reading and spelling could take the following shape:



As we can see from the above diagram, rhyme leads to phoneme detection but it has also a separate path to reading but not to spelling. Phoneme detection had a separate path to reading and also to spelling.

These results show that phonological awareness is related both to reading and spelling but they do not give any evidence for a possible relation between reading and spelling. Goulandris (1991) carried out a small longitudinal study of 27 British children to assess whether there are causal interactions between early spelling and later reading. Verbal intelligence (vocabulary), non-word spelling, reading, and spelling were used to predict reading and spelling one year later. Even when verbal intellingence, reading age, and spelling age were partialled out, nonword spelling still predicted reading and spelling one year later. This finding demonstrates that children's ability to generate phonetic spellings is the precursor of the eventual acquisition of alphabetic reading.

1.III.a.ii. Evidence from languages other than English

The connection between phonological awareness and literacy acquisition is not particular to learning written English. It has also been shown in many other written languages which use alphabetical representation such as Spanish (Carrilo, 1994; Defior & Tubela, 1994), Portuguese (Carraher, 1987; Alegria, Pignot & Morais, 1992; Cary & Verhaighe, 1994), German (Wimmer & Hummer, 1990; Wimmer, Landerl & Schneider, 1994), Norwegian (Lundberg, 1991; Hoein, Lundberg, Stanovich & Bjaalid, 1995) and Greek (Porpodas 1993; Porpodas, 1990; Porpodas, Pantelis & Hantziou, 1990; Porpodas, 1989; Aidinis, 1994; Aidinis & Nunes, 1997).

There are at least three ways of breaking up words into sounds. It is possible to break up words in syllables, phonemes, and also to separate out onset and rime (Goswami and Bryant, 1990; Treiman, 1983; Morais, 1991). Some languages, like English and German, have many monosyllabic words and quite complex syllables. In these languages, it is likely that, alongside awareness of phonemes, onset-rime awareness can make an independent contribution to reading. Onset-rime awareness, when tested with monosyllabic words, requires children to analyse a complex syllable into units which differ from an analysis of the same syllable into phonemes. The onset-rime distinction is not only a simpler phonological analysis task but also allows for different sorts of insight into the regularities of the language: the greater regularity in the phonological and orthographic correspondences at the level of onset-rime in English was already pointed out by Goswami and Bryant (1990).

Other languages, like Portuguese and Greek, have fewer monosyllabic words and a simpler syllabic structure. In fact, in Portuguese it is not easy to construct onset-rime or phoneme oddity tasks (testing for initial, middle, and end phoneme) with monosyllabic words because there are too few monosyllabic words that can be used

in developing such tasks. In these latter languages, syllables seem to have a simpler structure and play a different role in learning to read and write: in fact, the syllable is often used as a unit of analysis in reading instruction and even in the measurement of reading skills (see Martins, 1994).

In examining whether different levels of phonological analysis influence children's reading and writing, Hoein, Lundberg, Stanovich, and Bjaalid (1995), working with a large sample of Norwegian first graders (8-year-olds; n = 1509), obtained results that indicated an independent contribution of different sorts of phonological analysis to the prediction of reading and writing. They included in their study phoneme, syllable, and onset-rime tasks and found that the three factors which were extracted from the set of eight tasks used contributed significantly to reading as measured by a word recognition task. Phoneme awareness explained far more variance than the other two; rhyme awareness made an independent contribution to reading even after the other variables were included in the equation; syllable awareness was the weakest predictor and explained a very small amount of unique variance but remained significant (a finding that the authors attribute to the fact that their sample was very large).

Another study which shows that different sorts of phonological analysis might play different roles in learning to read and write was carried out by Wimmer, Landerl, and Schneider (1994). Working with German children, they confirmed the finding that different levels of phonological analysis make separate contributions to the prediction of word reading but observed in German a slightly different picture from that described for English and Norwegian. The study by Wimmer, Landerl, and Schneider was a longitudinal analysis of reading predictors. They presented the onset-rime and phonological analysis tasks (involving initial, middle, and final consonants) to pre-schoolers (age range 6 to 7 years). The reading and spelling tasks were given twice: in one study, when the children were in grades one and three, and

in the second study when they were in grades one and four. Wimmer, Landerl, and Schneider used two predictors - the initial sounds were combined in one score (onset) whereas the middle and final sounds and rhyme detection were combined in a second score. The significance of these two predictors varied with the time of the reading test. In their first study, onset detection was a significant predictor of one reading and one spelling task in grade one, after IQ and age had been partialled out, but rhyme detection was not. By grade three, the importance of the predictors had changed completely: their rhyme score was a significant predictor of all tasks whereas onset was no longer significant. In the second study, carried out with a larger sample, the increase in significance of their rhyme score as a predictor of spelling (no reading tests were reported in grade four in the second study) was replicated; however, this second study did not show a decrease in the predictive power of the onset score. Although the results of this study are difficult to interpret in detail (because their rhyme score included the results from the middle and final phoneme detection tasks), they indicate that different sorts of phonological analysis should be considered in the prediction of learning to read and spell in German and that the significance of the same sort of phonological analysis might vary across time.

Working with Greek children, Aidinis and Nunes (1997) investigated whether analysis at the levels of phoneme and syllable make significant and independent contributions to reading and writing. They gave first and second graders syllable and phoneme oddity tasks, and reading and spelling tasks. The phonemic and the syllable tasks made independent and significant contributions to reading and writing even after age and the other phonological task were partialled out. These results show that both syllables and phonemes should be considered in the prediction of reading and spelling in Greek and that the significance of the same sort of phonological analysis might vary across time.

In summary, research in the area of phonological awareness has shown that when

children begin to read and write they rely on different types of phonological strategy. Children, at least at the age of five, have the ability to analyse spoken words into smaller units such as syllables, onset-rime and phonemes, with the latter being more difficult. The evidence from these studies supports the hypothesis that reading is a complex task and requires the participation of more than one sort of phonological awareness. The use of phonological strategies cannot be related only to the awareness of phonemes. The larger phonological units that children use at the beginning of their literacy development may vary from language to language. Onset-rime, for example, might be of little importance for Greek because of the very small number of monosyllabic words. Syllable segmentation seems to play a very important role for literacy acquisition in Greek. Strategies related to the segmentation of units larger than phonemes may be important at the beginning of reading development. If this is the case then the syllabic structure of the words might influence children's reading.

1.III.b. Regularity effects in reading

What seems to be important in the use of phonological strategies in reading and writing is the spelling to sound regularity. Words are usually divided into two major categories: regular and irregular or exception words. Words that can be read by the application of phonological rules fall into the first category while words that break the phonological rules fall in the second category. Words belonging in the latter category have also been characterised as involving variant-unpredictable spelling patterns (Venezky, 1995). Regular words have also been divided into two groups: words where their letters map directly onto the sounds present in them - words involving invariant spelling patterns (Venezky, 1995) or transparent words (Rack et al., 1994) - and words where their letters do not map directly onto the sounds present in them - words involving variant but predictable spelling patterns (Venezky, 1995) or opaque words (Rack et al., 1994) or words

involving conditional rules (Marsh et al, 1981).

Differences in reading regular and irregular words have been reported in the literature by a number of researchers (Backman, Bruck, Hebert and Seidenberg, 1984; Seymour and Porpodas, 1980; Coltheart, Laxon, Keating and Pool, 1986; Barron, 1980; Glushko, 1979; Olson, Kliegel, Davidson and Foltz, 1984; Ellis, 1984). Backman et al. (1984), for example, gave children from second to fourth grade and high school students a list of 80 words and 60 non-words to read. Both words and non-words were divided into three groups: exception and regular inconsistent, ambiguous and regular. They found that children of all age levels made significantly more errors in exception, regular inconsistent and ambiguous words than in regular words. This difference was greater for the younger groups and the poor readers while both the fourth grade children and the high school students performed similarly indicating that they have both started to cope with the reading of these words. The vast majority of errors in word reading were regularizations and in non-word reading children preferred to apply grapheme-phoneme correspondence rules in pronouncing them, resulting in regular pronunciations, rather than by analogy to irregular words.

Barron (1980) tested whether there is a regularity effect on reading by using a lexical decision task. Working with grade six children (24 good readers and 24 poor readers) Barron asked them to decide whether a string of letters was a word or not. Half the items were regular words and the other half were irregular words. Non-words were generated by changing one letter of the real word. He found that good readers were influenced by spelling to sound regularity, as was shown by their reaction times, but not the poor readers. Both groups made more errors on the irregular than regular words. From this study it can be concluded that it is easier for children to decide whether a string of letters is a real word when invariant spelling patterns are involved than when variant unpredictable spelling

patterns are involved.

In contrast to the above studies, Coltheart, Laxon, Keating and Pool (1986) did not find a regularity effect on reading. They gave 46 year two children a lexical decision task and a reading task. In both tasks there were words and non-words. The words were divided into regular and irregular and the non-words were divided into homophonic and non-homophonic to real words. In both the lexical decision and the reading tasks they did not find any significant differences between regular and irregular words but significant differences between the homophonic and non-homophonic non-words were found.

Rack, Hulme, Snowling and Wightman (1994, experiment 3) tested the hypothesis that there is a difference in the ease with which words that involve invariant spelling patterns (transparent according to the authors) and words involving variable but predictable spelling patterns (opaque words according to the authors) are learned by children. In this study 15 five year old children were taught to name unfamiliar words which were in their spoken vocabulary but not in their reading vocabulary. The words were divided into two groups, transparent and opaque. All the letters of the transparent words corresponded to a sound in the words' pronunciation and this sound was the most frequent or typical sound of this letter (e.g. sand, basket). In the opaque words at least one letter did not correspond to a sound or it corresponded to a sound that was atypical of this letter (e.g. knife, watch). The results showed that the children recalled the transparent words more easily than the opaque words (average scores 34.2 and 24.4 respectively). These results show that for words that can be read on the basis of phonological rules there is a developmental progression from simple to complex.

In Greek, regularity effects have been reported by Porpodas (1989; Porpodas,

Pantelis and Hantziou, 1990; Porpodas, 1990; Porpodas, 1993). In all these studies children's reading (children were either in the first grade or in the fourth grade at school) was assessed by a list of words half of which were regarded as orthographically regular and the other half as orthographically irregular. The distinction, however, between regular and irregular words employed in these studies does not fit the characteristics of the Greek language where reading is always predictable based on phonological rules, simple or hierarchical. A distinction between regular words that involve invariant spelling patterns and regular words involving variant but predictable spelling patterns would be more appropriate in describing the two groups of words used in these studies. Children performed significantly better on regular than irregular words - as classified by the author - and the difference was greater for the younger children and for the poor readers and spellers. These results offer an indication that even in a transparent orthography children acquire the simple phonological rules first and the more complex ones later.

The results of the above studies are consistent with both Marsh's and Frith's models of reading development. In Marsh et al.'s theory (1981) words involving conditional rules are learned during the last stage of literacy development (the orthographic stage). Bryant and Goswami (1990) agree with Marsh's claim that complex, conditional orthographic rules are not learned till quite late on. In Frith's theory (1985) these words are learned during the second phase of literacy development, the alphabetic phase. It is during this phase that children use phonological rules in their reading and as Frith argues there is a developmental progression during this phase from simple phonological rules at the beginning to complex later on.

Drawing together the results of these studies and the characteristics of the Greek language, a question that can be asked is whether Greek children use different

phonological strategies in reading and whether the acquisition of these strategies follow a developmental progression from simple to complex. If they use different phonological strategies at different stages of their development then differences between words involving invariant spelling patterns and words involving variant but predictable spelling patterns should be found. Alternatively, it might be the case that they master both linear and complex strategies from the start because of the transparency of the orthography. Another question that can be asked is at what age do Greek children learn these more complex spelling patterns? Do children learn these spelling patterns by rule or by analogy? Do Greek children use contextual cues in their reading in order to overcome their incomplete graphophonemic information.

1.III.c. Analogical reasoning and reading

Analogical reasoning has been a focus for study in cognitive psychology. It is thought to be a major strategy for learning and classification. In the classical definition, provided by Aristotle, analogy involves at least four terms with relational similarity where the second term is related to the first as the fourth is related to the second (Goswami, 1992). Analogical reasoning has been used in problem solving where children had to understand the relation between a "base" problem and its solution in order to solve another problem.

A very useful strategy for reading unknown words is by drawing inferences from the pronunciation of familiar words in order to work out the pronunciation of the unfamiliar word with a similar spelling pattern. This process of reading has been referred to as use of analogy (Goswami, 1986; 1988; 1990; 1991; 1992; 1993; Goswami and Bryant, 1990). Analogical reasoning has been found to be available even to children of the second grade (Sternberg, 1977). The use of the strategy of analogy in reading as it is defined by Baron (1979) is a conscious strategy of

recalling a similar word and then modifying its pronunciation. A similar definition for analogy in reading is given by Marsh and Desberg (1983) when they say that "in the analogy strategy the child searches for a known form in memory and produces a novel form by analogy to the known form" (p. 150). Goswami (1992) argues that in using analogies in reading it is important to pay attention to the relations between spelling patterns and sound.

Conscious use of analogies has been reported by adults (Baron, 1977; Glushko, 1979) and by elementary children (Baron, 1979). According to Marsh et al.'s theory (1981) of reading development, adults and older children have and use a number of different strategies including analogy. The explanation for this late involvement of various strategies in reading is based on the claim that as reading proficiency increases and the reader has to encounter materials with uncontrolled vocabulary there would be a shift from word recognition based on access to phonemic form to word recognition on access to meaning. In addition the reader may internalise visual word forms.

In an experiment carried out by Marsh, Friedman, Welch and Desberg (1981, experiment 1) they tested whether second and fifth grade children and college students use the strategy of analogy. They gave children two paragraphs to read in which were included four words that could be pronounced one way if subjects used a decoding strategy and a different way if they used analogy (for example the word "faugh" can be read as /faw/ using a decoding strategy or /faff/ by analogy to laugh). They found that both fifth grade children and college students produced the same percentage of analogy responses (about 38%) a percentage that differed from Marsh et al.'s (1977) study where adults' analogy responses were about 70%. They also found a significant difference in the analogy responses between fifth and second grade children. The authors concluded the analogy strategy is an optional strategy for adults and its use depends on task

factors although this strategy is available by stage four (according to Marsh's theory) of reading development.

In another experiment the same authors tested whether the analogy strategy is available by stage three (according to Marsh's theory) of reading development (Marsh et al., 1981, experiment 2). They asked 20 second and 21 fourth grade children to read two lists of words. The first list contained 20 high frequency words, half of them regular and the other half irregular. The second list contained 20 non-words generated by changing one letter of the words from the first list. The children were told that non-words were real words with one letter changed. The results showed that there was no significant difference between children in grade two and grade four in the use of analogy, suggesting that even stage three children can read by analogy but they do not do so spontaneously. This conclusion arose from the fact that all the children were instructed in a way to use the strategy of analogy.

Using a different experimental paradigm Goswami (1986) gave kindergarten, first and second grade children words and non-words to read that were either analogous or not-analogous to a clue word. Non-words derived from the real words by changing one letter so that the spelling pattern for the analogy remained intact. The words and non-words shared the same orthographic sequence (always consisting of three letters) with the clue word either at the beginning or at the end of the word. There was also a list of control words which shared the same three letters with the clue word but were not in sequence. The children were divided into three groups: beginning, where the target words were analogous to the clue word at the beginning; end, where the target words were analogous to the clue word at the end; no clue, where no clue word was presented. Children were seen in six sessions and in each session, depending on condition, there were two target words, two common letter words and three control words which were either

target or common words but for another clue word. Children performed significantly better in the target words when there was a clue word present than when there was none. Children used the shared orthographic sequences in order to read words or non-words and this resulted in better scores for target words than for common letter or control words. This was true for the two older groups. For the youngest group, the non-readers, there were very small scores (hardly above zero) but there was some indication of the use of analogy especially for the words or non-words that shared an orthographic sequence with the clue word at the end. These results, according to the author, showed that even young children can use analogies in reading. They certainly show that even young children can use their knowledge about fixed pronunciations in order to read unknown words but it is doubtful whether this is analogy according to Marsh's definition of analogy.

Similar results have been obtained in other studies (Goswami, 1988; 1990a; 1990b; 1991; 1992; Goswami and Bryant, 1992). In all these studies children's phonological skills in segmenting words into onset and rimes were essential because all the analogies were based on those two phonological units. In these studies it was established that children make more analogies when the basis for the analogies is the rime of words than when the basis for the analogy involves orthographic sequences formed by the onset and part of the rime.

1.III.c.i. An analogy model of reading development

Goswami (1993) proposed an interactive analogy model of reading development. According to this model children's phonological knowledge before entering school guides their expectations about how the language works. Based on their phonological knowledge children use a cognitive strategy (Goswami names this strategy as analogy) in order to work out consistent relations between spelling

patterns and sound. The better the child is at phonological awareness - especially in segmenting words into onset and rime - the more likely s/he is to read unknown words based on shared spelling patterns with known words. The child starts to read unknown words by using consistent spelling patterns that correspond to the onset-rime features of words whose pronunciation s/he knows. Later, as the child's phonological knowledge develops further, the child starts to use all the constituent phonemes in the word and to include context sensitive pronunciation rules in reading. Phonological skills and the pronunciation of consistent spelling patterns in reading cannot be seen as separate skills but as intimately connected.

Evidence for this theory comes from Goswami (1993) who carried out three experiments. In the first experiment she tested the hypothesis that children at the beginning concentrate on spelling patterns that correspond to the onset-rime distinction. Twenty children from infant classes (mean age 6 years 5 months) with a reading age equivalent to their chronological age were asked to read a total of 36 words once at the pre-test and once at the analogy test which followed the pre-test. Before the analogy test children were taught how to read a clue word and were told that knowing how to read this word would help them to read some of the words that they had tried in the pre-test. There were four clue words for each of which there were nine words divided into three groups: onset-vowel words that shared the onset and the following vowel with the clue word; rime words that had the same rime with the clue word; and vowel only words that shared only the vowel with the clue word. The results showed an improvement in children's scores from pre-test to analogy test which was significant only for the rime words. These results confirmed the hypothesis that children at the beginning read words based on the pronunciation of consistent spelling patterns that correspond to the rime of the word.

In the second experiment the same experimental paradigm as in the previous experiment was used with the difference that the vowel of the words was always a digraph. Also a fourth group of words was added. The words in this group shared three letters with the clue word but not in sequence. Twenty grade one and grade two children (mean age 6 years 4 months) with reading ages of 6 years 7 months to 7 years 2 months) participated in this study. Children in this experiment were better readers than the children in the previous experiment. Goswami hypothesised that children would perform better on the words that shared their rime with the clue words. She also hypothesised that these children, because they were better readers than in the previous experiment, might use the onset-vowel spelling pattern or only the shared vowel digraph and read better the words that shared this spelling pattern with the clue word. Children performed better in the analogy test than in the pre-test for rime, onset-vowel and vowel only words but not in the common letter words. Children's performance was superior in the rime and the onset-vowel words than in the vowel only words. These results show that as children become better readers they can use their knowledge of fixed pronunciations of spelling patterns that does not correspond only to the rime of the words.

In the third experiment the children (24 grade 1 and grade 2 children, mean age 7 years 3 months) were even better readers than the children from the two previous experiments (mean reading age 7 years 6 months). All the words in this experiment began or ended with a consonant cluster. There were four different kinds of words in relation to the clue word: consonant cluster words that shared a consonant cluster with the clue word either at the beginning or at the end; cluster vowel words that shared either the initial consonant cluster and the vowel or the rime with the clue word; vowel only words that shared only the vowel with the clue word; and common unit control words which share a few or no graphemes with the clue word. Because children in this experiment were better readers than

in the other two experiments and they were expected to have better phonological skills they were expected to read the words that shared only one vowel or a consonant cluster with the clue word better than the common unit control words. In addition they were expected to read the words that shared the onset-vowel spelling pattern and the rime better. The results showed that children performed better in the analogy test than in the pre-test for the rime or the consonant cluster vowel words but not for the consonant cluster and the vowel only words. That means that children can use their knowledge of how to pronounce specific spelling patterns in order to read unknown words but these spelling patterns must correspond to rime or onset and vowel units. Children are unable at this age to use pronunciation of single phonemes or clusters even though these clusters correspond to the onset of the word.

The three experiments described above show that even six year old children can use their knowledge of fixed pronunciations - corresponding to the rime of the word - in order to pronounce unknown words. As children become better readers they can use fixed pronunciations that correspond to rime plus the following vowel. Goswami argues that this is evidence that even young children can make analogies. Two points of caution have to be made about the results of the above studies. The first one has to do with the spontaneous use of the strategy of analogy by young children (Marsh et al., 1981). Goswami (1986) concludes that children can make analogies in reading if the basis for these analogies is provided. Baron's and Marsh's definition of analogy implies that the child consciously is searching for a similar word in memory and modifies the pronunciation of this word in order to read the unknown word. Goswami's results cannot be taken as evidence for the spontaneous use of analogy in reading since the clue word was always in front of the children and they were allowed to refer back to it at any time. The second point has to do with the basis for the analogy. All the target words shared either the beginning or the end (which formed the

rime) orthographic sequence with the clue word and they were monosyllabic. There is no evidence that children can use analogies in order to read polysyllabic words. Also, this experiment does not provide any information about whether children would still use analogies if the middle letter of the words used had been changed. Hence, the results of these experiments can be seen as demonstrating children's use of their knowledge about fixed pronunciations rather than analogies at least in the sense that Marsh defines analogy in reading or in the classical definition of analogy.

In a longitudinal study, Muter, Snowling and Taylor (1994) investigated whether children can read words that share spelling patterns with a known (clue) word. The children were studied from the age of four onwards and at the age of six years they received an analogy test. The children were pretested on a list of analogy and control items. Then children were trained to criterion on a series of clue words on which the analogy words were based. The analogy words shared the rime with the clue word while the control words also shared three letters with the clue words but they could not be read by rime analogy. At post-test children were assigned to two groups. Half of the children had the clue word exposed while the other half were tested without being able to look at the clue word. The children performed better at the post-test than at the pre-test but the size of the effect was substantially smaller if the clue word was not exposed at the post-test. This result makes it doubtful whether or not young children can use the strategy of analogy spontaneously. They also found that the better reader a child is the better s/he can use his/her knowledge of spelling patterns in reading. In another study with the same children (Muter et al., 1994, experiment 2) they found a strong connection between children's rhyming skills at the age of six (the same age that the analogy test was given) and use of analogy. However, the rhyming skills as measured at the ages of four and five did not significantly predict the scores in the analogy tasks. These results do not support a strong causal

connection between rhyming awareness and use of analogy as hypothesised by Goswami (1993).

1.III.c.ii. Training studies for the use of analogy in reading

In a training study, Peterson and Haines (1992) tested the hypothesis that orthographic analogies based on onset and rime units are importantly related to children's letter-sound knowledge and also facilitate their segmentation skills. They trained kindergarten children (mean age 5 years 10 months) to read words based on shared orthographic units that corresponded to the onset and rime units. Before the training both the experimental and the control groups were tested in segmentation ability, letter sound knowledge and word recognition by analogy. After the pre-test the children were divided into three groups - high, middle and low - based on their segmentation skills. Then the children in the experimental group received a maximum of seven 15 minutes training sessions while the children in the control group remained in the regular kindergarten curriculum. The training sessions focused on the segmentation of words into onset rime units and the relation between the words that share these units. After the training sessions the children were tested again on segmentation ability, letter sound knowledge and word recognition by analogy. The results showed a greater improvement in the experimental group children's performance on segmentation ability compared with the improvement of the control group. In letter sound knowledge the experimental group showed a significant improvement but there was no improvement for the control group. In the word recognition test the high and middle segmenters showed a significant improvement in their performance while the low segmenters did not improve significantly. These results showed that training children to use spelling patterns that correspond to the onset rime units of the syllable does not only improve their ability to read words using their knowledge of the pronunciation of these units but also improves their

segmentation skills and letter sound knowledge. These results also show that there is a connection between children's segmentation ability, letter sound knowledge and reading by making inferences from the pronunciation of known spelling patterns in order to read unknown words that share the same spelling patterns. The presence of the clue word throughout the testing in the word recognition by analogy test and the absence of multisyllabic words and words with complex onsets and rimes in the testing and training words advises some caution in the interpretation of these results.

The hypothesis that readers who possess some decoding ability would be able to read words that share an orthographic pattern with a known word whereas the readers that do not have this decoding ability will not, was tested by Ehri and Robbins (1992). This hypothesis was based on Ehri's theory (1992) that phonological decoding ability enables children to form connections between the spelling and the pronunciation of the words and to keep these connections in the memory in order to access the pronunciation and the meaning of the words. Thus, in order to read an unknown word based on shared spelling patterns the child must form connections to the base word and store these connections in the memory. Some sort of phonological decoding is needed, however, to form these connections.

In the study carried out by Ehri and Robbins (1992) kindergarten and Grade one children (mean age 6 years and 4 months) were divided into two groups, decoders and non-decoders according to whether they could decode simple CVC non-words. Children were pretested on a word reading test, a nonsense word reading test and a letter naming test. Then children were divided into two groups, an analogy training group and a control. Both groups received training but with different sets of words. The words in the analogy group shared rimes with the transfer words while the words in the control group shared the two vowels in the

middle of the word. All the words had a long vowel but this vowel was spelled with double vowel (e.g. KAAV for cave). After the word training all the children had to read the transfer words which was then followed by a spelling task in which children had to spell the words that they had just practised in reading. Children were told that the transfer words shared all the letters except the first with the training words. For the decoders there was a significant difference between the analogy and control groups in reading the transfer words. For the non-decoders there was not such a difference and the improvement between pre-test and post-test was the same for both the control and the analogy group. These findings show that children who are good in segmentation benefit more from training in using the fixed pronunciation of spelling patterns and support the hypothesis that beginners need some decoding skill to transfer their knowledge of a spelling pattern of a known word in order to read an unknown word.

In the studies described above and in the studies carried out by Goswami simple words were used. According to Marsh et al. (1981) the strategy of analogy is used for the reading of words like "laugh", where pronunciation cannot be obtained from linear grapheme-phoneme strategies or even from contextual rules. None of the words used in these experiment surpass simple phoneme-grapheme correspondences or contextual and there was no need to use analogy in reading these words according to Marsh's claim. The importance of the onset-rime phonological units in children's reading can be explained by the strong relation between rhyme awareness and reading found in several studies (see for example, Goswami and Bryant, 1990) and not by the use of the analogy strategy.

1.III.c.iii. Studies in languages other than the English

Children's ability to use analogy from known words in order to read unknown words that share spelling patterns with the familiar words have been well

documented in English. English has been referred to as a deep orthography involving complex spelling patterns (Treiman, 1993). In other alphabetic languages with a shallow orthography such as Spanish, German or Greek this strategy might not be used because beginning readers rely more on an alphabetic strategy (Wimmer and Hummer, 1990; Porpodas, 1993).

Sebastian and Vacchiano (1995) tested whether or not young Spanish children and adults use the strategy that has been referred to as analogy. In one experiment they gave six to ten year old children a story to read which included 34 experimental items all of them involving the pronunciation of two letters, C and G. The pronunciation of these two letters is dependent on the following letter. The experimental items were divided into three groups: control words, change pseudowords and unchanged pseudowords. Control words were real words which always included either C or G. Both groups of pseudowords were generated from real words, other than those used as control words, by changing one or two letters. The difference between changed and unchanged pseudowords was that in the former the changing of the letter in order to create the pseudoword signified a change in the pronunciation of the critical letter (C or G) while in the latter the pronunciation of the critical letter remained the same. Children at all ages made more mispronunciations in the changed pseudowords than in the unchanged ones. The absence of a significant interaction between age and type of stimuli indicates that the same mechanisms for reading these words were operating in all the age groups.

In a second study Sebastian and Vacchiano (1995, experiment 2) gave 9 to 13 year old children and adults words and pseudowords to read similar to the previous experiment. In this study the subjects were assigned to two groups. The first group read two stories in which the words and pseudowords were included and the second group read them in isolation. Subjects performed better in the

isolation task than in the story task. There were more mispronunciation errors for the changed than the unchanged pseudowords. The percentage of mispronunciation errors of changed pseudowords did not decreased with age. Given these results and the results of the previous experiment the authors concluded that Spanish readers, whether beginners or skilled, use the strategy of analogy when they are reading similar to their English counterparts.

There are, however, some reasons for caution about the authors' main conclusion. The first is that the stimuli used in these experiments involved complex phonological rules, known as conditional or hierarchical (Marsh et al., 1981) which are not learned till quite late in reading development (Marsh et al., 1981; Goswami and Bryant 1990). Because there was an improvement in reading of the pseudowords with age there is no way to know whether this improvement was due to the use of the strategy of analogy or due to the learning of the conditional rule. Secondly, in the English studies on the use of the strategy of analogy in reading the target words always shared a spelling pattern that corresponded either to the rime or to the onset and the vowel of the clue word. In the English experiments the fixed pronunciations of specific spelling patterns enable children to draw inferences in order to read the target words. This cannot be said for the target words in the Spanish experiments because there was no constant spelling patterns and the clue word was not taught as in the English studies. There is no indication that children knew how to read the real words from which the changed and unchanged words were generated since these words were not included in these studies.

In summary, the studies on children's use of constant spelling patterns (usually onset-rime) or fixed pronunciations for reading unknown words show that even very young children can use this strategy in reading if they are instructed to do so and also have the clue word in front of them. Based on the classical definition of

analogy this strategy cannot be characterised as analogy because there are not four terms with relational similarity in which the fourth is related to the third as the second to the first. The use of this inference strategy in other languages with more transparent orthographies than English is doubtful. In some of these languages, in Greek for example, onset and rime may not play a significant role in children's literacy development because there are very few monosyllabic words. It might be that in these orthographies an alphabetic strategy might be good enough for reading all the words. In these languages phonological units larger than phonemes, e.g. syllables, may help children to read at the beginning of their development.

1.IV. The use of contextual cues in reading

Although phonological strategies are important for reading development some theorists believe that the most important factor in reading is meaning. According to this view reading is like speaking where children use contextual cues to work out the meaning of the language they are trying to interpret. This claim is based largely on the work of Goodman (1967, 1982) and Smith (1979, 1994) according to whom skilled reading is primarily an activity of using the syntactic and semantic redundancies of language to generate hypotheses, or guesses, about the text yet to be encountered (Tunmer and Chapman, 1995). In the words of Goodman (1967) "reading is a selective process. It involves partial use of available minimal language cues selected from perceptual input on the basis of the reader's expectation. As this partial information is processed, tentative decisions are made to be confirmed, rejected or refined as reading progresses. More simply stated, reading is a psycholinguistic guessing game" (p. 126-127). Fluent readers, according to Goodman and Smith, are more able to make use of contextual cues in ongoing sentence processing while beginning and poor readers

are less able to use contextual cues.

A second view concerning the use of contextual cues in reading is that language prediction skills are not important either for beginners or for fluent readers. The basis for this view comes from the results of Gough (1983) who claimed that the average predictability of content words in running texts is about 10%. Because the meaning of the text depends disproportionately on the meanings of its least familiar and predictable words children will have a one in ten chance of guessing the correct word unless they are reading low level texts with repeated sentence structures, a high degree of predictability and a large amount of picture support.

A different view that the effect of context on speed of ongoing word recognition during reading decreases with increasing age has been proposed by Stanovich (1984, 1986). Stanovich (1980) in her interactive compensatory model of reading acquisition argued that poor readers rely on context to compensate for their poor decoding skills, whereas good readers, who are good decoders, have less need to do so.

Evidence for Stanovich's claim come from Nicholson (1991). Nicholson (1991) tried to replicate Goodman's classic studies on the effect of context in reading. He gave six to eight year old children passages to read in context and then asked them to read the same material in list form (the order of presentation was opposite to that in Goodman's study). Nicholson found that poor and average readers of six and seven years old showed significant gains in word reading with context. When the materials used were at a comparable level of difficulty only the poor readers in all the age groups and the average younger readers showed significant gains with context. In a second experiment Nicholson used the same materials but he changed the order of presentation. In this experiment children were given first the words in a list and then in passages providing context (the

same order as in Goodman's study). Most groups gained significantly in context. When children were given materials of comparable difficulty the benefits of context went to the poor and average readers and to the younger good readers. In conclusion, Nicholson's study showed that the effect of context in reading may have been overestimated. The results also showed that the use of context decreases with increasing age and skill.

Adams and Huggins (1985) assessed whether there are ability related differences in the use of context. In their studies two hypotheses were tested. The first one was that poor readers should be encouraged to rely on context in order to identify words and discouraged from using the words' phonics codes. The second one was that poor readers' greater reliance on context results from poor decoding skills. The authors claimed that poor readers, in order to overcome their difficulties in word recognition, should improve their decoding skills and in this sense they should be discouraged from relying on contextual facilitation and encouraged to attend to words' phonics codes. In a series of experiments Adams and Huggins gave children from second to fifth grade 50 words to read, first in isolation and then in sentences. All the words were irregularly spelled and they were presented in order of frequency (from high to low). In the sentence the target word was always the last word. They found that children from all age and ability groups improved significantly in their accuracy scores of reading irregular words when they were presented in context. They also found that 'the facilitative potential of context is a function of the subjective familiarity of the word to be recognised" (p. 274). In other words context facilitated the recognition of words of intermediate familiarity (which varied with age and ability). Words of greater familiarity were not read better in context than in isolation and words of lesser familiarity were not read more accurately in context than in isolation.

Based on their results Adams and Huggins (1985) identified three stages in the

development of sight word acquisition. In the first stage children tend to read words by applying spelling to sound rules. This results in incorrect reading of irregular words especially of low frequency ones such as the last words on Adams and Huggins' list. This ability to produce pronunciations for irregular words which although incorrect can also be seen as "not-so-distant approximations of the correct words" (Adams and Huggins, 1985, p. 276) reinforces the claim that phonological recoding ability is essential for acquiring word specific knowledge (Gough and Walsh, 1991). In a second or transitional stage children are able to recognise words correctly in context but in isolation either recognise them with hesitation or do not recognise them. In this stage, although children have internalised the representations of these words, these representations have not yet been refined to support automatic or reliable direct access. In the last stage, the most sophisticated one, the word is securely represented in the children's visual lexicon. These are the words that can be correctly recognised both in isolation and in context.

On the basis of such findings Tunmer and Hoover (1992) proposed that language prediction skill enables beginning readers to use their incomplete graphophonemic knowledge in combination with their knowledge of the constraints of the sentence context in identify unfamiliar words, both regular and irregular. This combination helps children increase both their word-specific knowledge and their knowledge of phoneme-grapheme correspondences. According to Tunmer and Chapman (1995) use of contextual cues will enable beginning readers to monitor accuracy in word identification by providing them with immediate feedback when they attempt to read an unfamiliar word and their response does not conform with the surrounding grammatical text. Contextual information could be a backup support when children attempt to read an unfamiliar word based on their incomplete spelling-sound correspondences and confirm their response from the surrounding context. In this case children's

knowledge of grapheme-phoneme correspondences will also be improved by connecting the pronunciation of this word with its spelling (Ehri, 1992).

In studying the hypothesis that less skilled readers are inferior relative to skilled readers in syntactic awareness, which results in slower progress through the stages of sight word reading (Adams and Huggins, 1985), Bowey (1986) gave fourth and fifth grade skilled and less skilled readers a reading task and a syntactic awareness task. She found that skilled and less skilled readers differed significantly on the grammatical awareness measure. The results also showed a high correlation between grammatical awareness and decoding skills.

In a more direct test of the relation between syntactic awareness and reading acquisition, Tunmer, Nesdale and Wright (1987) gave some 60 second and fourth grade children a reading test and a syntactic awareness test. Children were divided into three groups, good, average and poor readers. Syntactic awareness was assessed by an oral cloze task and an oral correction task. Significant differences in syntactic awareness across ability groups for each grade were observed. Good second grade readers performed better than poor fourth grade readers and similarly to average fourth grade readers. Taken together these results suggest that syntactic awareness is strongly related to learning to read.

In a longitudinal study Rego and Bryant (1993) tested the hypothesis that both phonological skills and language prediction skills are related to children's reading. They gave children initially (at the age of 5 years and 6 months) tests of phonological awareness (a phoneme oddity and a phoneme tapping task) and semantic and syntactic skills (a close task, a sentence anagram task and a sentence completion task) and a standardised reading test. In a second session (at the age of 5 years and 11 months) they gave children a contextual facilitation task in which they placed in sentence contexts the ten first words that children missed

on the reading test. The sentence was read aloud by the experimenter and the child had to read only the target word which was presented on a card. Rego and Bryant found that the measures of semantic and syntactic awareness taken in the first session predicted contextual facilitation in the second session. However, neither of the two phonological awareness measures made an independent contribution to contextual facilitation.

In exploring the connection between phonological recoding skill in reading exception words in context and in isolation, Tunmer and Chapman (1995) gave second and third grade children a mispronunciation correction task. This task comprised 80 regularised pronunciations of exception words which were presented first in isolation and then in sentence context. The sentence contexts were underdetermining ones. The task for the child was to find the word that a puppet was trying to say. The puppet always mispronounced the words using a regularised pronunciation. In the sentence task children were told that one of the words in the sentence was pronounced wrongly and they had to find this word and provide the correct pronunciation. Tunmer and Chapman found that mispronounced words were identified more easily when presented in context than in isolation. This was true for both the age groups although third grade children performed better than the second graders. Also more common words were easier to identify than less frequent words. The authors concluded that sentence context makes a contribution to the identification of mispronounced exception words beyond that provided by graphophonemic information and greatly improves children's ability to identify mispronounced exception words even when the contexts are underdetermining ones.

In a second experiment Tunmer and Chapman (1995, experiment 2) tried to determine more precisely the relation of language prediction skill and phonological recoding ability to the identification of unfamiliar words in context.

They gave 289 year 2 and year 3 children four tests: a word reading test, an oral cloze task, a contextual facilitation task and a pseudoword naming task. In the contextual facilitation task children had to read 80 exception words of different frequency presented in isolation and in context. When the words were presented in context the experimenter read the sentence but not the target word. In the pseudoword naming task children had to read thirty monosyllabic pseudowords with increasing difficulty ranging from simple CVC patterns to blends, digraphs and vowel variations.

They found significant age and frequency effects. They also found that the 80 words were easier to read when presented in context than in isolation. The results showed that year 3 children made greater gains from context when they read words of lower frequency which reinforces Adams and Huggins' claim that contextual facilitation is greatest for words of intermediate difficulty. The correlations between contextual facilitation, reading and pseudoword naming task showed that beginning readers with moderate decoding ability can use their incomplete graphophonemic information in combination with sentence context information to read unfamiliar words. Language prediction skill and phonological recoding ability accounted for independent variance in beginning readers' ability to read unfamiliar words in context; the independent variance due to phonological recoding ability was four times larger than that of language prediction skill. The authors concluded that phonological recoding ability is necessary but not sufficient for the development of word specific knowledge and cannot be used as a substitute for word level information but only as backup support to confirm hypotheses about what unfamiliar words might be, based on available word level information.

This hypothesis can also account for words reading in Greek. In Greek, phonological strategies are used by young children right from the beginning of

schooling (Porpodas, 1993; Aidinis and Nunes, 1997), and there are no irregular words. There are, however, words that involve both simple and complex phonological rules. It is possible that Greek children, at the beginning of their reading, use contextual cues to facilitate their incomplete knowledge of spelling to sound correspondences. As their phonological awareness improves and they master the more complex rules there might be no need to rely on context for reading.

In summary, the results show that the relationship between context effects and reading may vary for the same subject across time. Tunmer and colleagues propose that linguistic context is most useful for non-expert readers (beginning or backward readers) who use context to guess when they cannot read a word. Expert readers rely less on linguistic context for word identification. However, it might be that the use of context in reading depends both on the skill of the reader and on the difficulty of the word. Young children might not rely on context to improve their accuracy when reading easier regular words but might show benefits from context when the word cannot be read on the basis of simple one-to-one phoneme-grapheme correspondence. In contrast, expert readers might not depend on context to increase accuracy even when reading more complex words. Thus it should be possible to observe within-subject and between-subject variation in the use of linguistic context for word reading.

1.V. Morphological strategies in spelling

There is no doubt that phonological strategies are of great importance especially in the first stages of literacy development. Children must learn to represent sounds by letters and vice versa in order to understand how language is represented in print. But learning to read and spell is not just a matter of

representing sounds by letters. Although essentially important, this is only a part of becoming literate. Bryant, Nunes and Aidinis (1997) have argued that another fundamental element in learning to read and spell is the link between morphology and script. According to their argument, in many alphabetic scripts it is impossible to learn to read and spell properly without taking into account another kind of building block used to form words, the morphemes. According to the definition of the Oxford Dictionary, morphemes are linguistic units which have a meaning or grammatical function and which cannot be further subdivided. The word γράφω (write), for example, has two morphemes: the stem "γραφ-" which has meaning and the inflectional morpheme "ω" which has the grammatical function of marking the present tense of a verb. Stems are significant units of meaning - words with same stem are usually related in meaning for example the words γράφ-ω, γραφ-ή, γραφ-είο, γραφ-έας (write, writing, desk, clerk) have the same stem and are related in meaning - but stems do not have grammatical functions. Other morphemes convey meaning and also have a grammatical function - the "ω", for example, has the function of marking the present tense of regular verbs in the active voice. Both types of morphemes have a particular form. Another class of morphemes that conveys meaning are the prefixes - the addition of the derivational morpheme "re", for example, in the verb write (rewrite) adds a different sense in its meaning (i.e. once more). As Bryant, Nunes and Aidinis (1997) point out "morphology is not independent of either grammar or meaning: it involves both grammar and meaning expressed in a particular form. Because of this constancy of form, morphemes are fundamental in learning to read and write in many scripts that are commonly referred to as "alphabetic", but could perhaps more appropriately be termed "morpho-phonic" (p. 2).

1.V.a. The links between morphology and writing

The importance of morphology in spelling can be documented in a variety of

languages. In many languages children cannot learn to write properly without taking into account morphology because there are instances in these languages in which spelling patterns are determined by morphology in a way that cannot be reduced to phonology. Bryant, Nunes and Aidinis (1997) have identified three kinds of link between morphology and writing: the first one is to decide between two or more alternative spelling sequences; the second is the spelling of silent morphemes; and the third one is the conventional spellings for morphemes which flout letter-sound correspondence rules. In some scripts one can find all three types, but other scripts contain instances of only one or two of them.

1. Deciding between two or more acceptable spelling sequences The first and probably the most common way in which spelling depends on grammar is in specifying a choice of one particular spelling pattern when there are two or more perfectly acceptable spellings of the same sound. For example, many Greek words end in the sound /i/ and this ending can be spelled in one of four ways - with single letters [η, ι] or with digraphs [οι, ει]. Feminine singular nouns and adjectives take the first of these spellings (e.g. η), neuter singular nouns the second (e.g. ι), masculine plural nouns and adjectives the third (e.g. οι), and third person singular active verbs in one conjugation take the fourth (e.g. ει). Because of this variety of alternative spellings for the same sound it is quite impossible to spell Greek words just on the basis of a thorough knowledge of these letter-sound relationships. One needs to use morphological as well as phonological strategies in spelling.

In English too, morphemes are the key to deciding between alternative spellings for word endings. The sound /ks/ for example, whenever it is the ending of a written word, is spelled either "x" or "cks". In deciding which of these endings to use, the decision must be based on morphology. If the word is a singular noun ("tax") or an adjective ("lax"), it has the "x" ending: if it is a plural noun or a

verb in the third person singular, present tense, the ending is "cks" ("cracks, "licks"). In other words, the presence of either the morpheme "s" for the plural of nouns or the "s" for the present third person singular of verbs determines the "cks" spelling for the /ks/.

2. Spelling silent morphemes The second link between morphology and grammar has to do with words which are homophones but are grammatically distinct. Although these grammatical distinctions are not pronounced, they are captured in writing. A striking example is the use of apostrophes in English. In English, apostrophes are used to represent possession but one does not actually pronounce an apostrophe: "the boys' sail" and "the boys sail" are pronounced in the same way, but have quite different meanings, and the apostrophe captures this difference. In French too, singular and plural nouns are written differently because the plural is marked with an "s" ending ("maison, maisons") but are usually pronounced in the same way: the written "s" ending is typically silent.

3. Conventional spelling for morphemes which flout letter-sound correspondence rules In this final link between morphology and spelling there is a direct conflict between letter-sound correspondence rules and the way in which morphemes are spelled. A very good example of this kind of link is the "ed" spelling at the end of regular past verbs in English. The final consonant in these verbs is pronounced in three different ways - /t/, /d/, or /id/ - in different verbs (e.g. "helped", "hired", "hated") and the constant spelling, "ed", on strict letter-sound correspondence rules does not represent any of these three spoken endings. The grammatical status of words like "helped", "hired" and "hated" is marked in the spelling of the endings of these words even though these endings are pronounced quite differently.

All these three links between morphology and spelling are related to the endings

of the words. Another important morpheme - in terms of its connection to the correct spelling of a word - is the stem, that is the morpheme defined by meaning rather than grammatical function. In many languages (e.g. English, Greek, Hebrew) the spelling of stems often remains constant even though the pronunciation might change when a derivational morpheme is added. In Greek, for example, the words "**ευχαριστώ**", "**ευχάριστος**" and "**ευχαρίστηση**" have the same stem. The second letter "υ" of all these words represents the sound /f/, usually represented by the letter "φ", although "υ" usually represents the sound /i/. In English too, in pairs such as know-knowledge and magic-magician, there are phonological differences but a common spelling. These examples suggest that there is an advantage in understanding connections between words with the same stem over a strategy of treating such spellings as irregular and attempting to learn them all in a rote fashion. Similar examples are found in Hebrew, where words sharing the same stem are spelled with the same three consonants which define their root, even if there are phonological changes when the root is embedded in a word of a different category (Bindman, 1997).

1.V.b. Evidence for the use of morphological strategies in spelling

Before becoming good spellers, children go through a developmental sequence leading to fluent spelling. There is clear evidence that when children begin to spell, they concentrate on alphabetic rules. This is very well demonstrated in children's invented spelling where there are numerous examples showing that children tend at first to represent the sounds of words phonetically (Read, 1986; Treiman, 1993). In the developmental sequence of spelling acquisition after this earliest stage, the "alphabetic stage" according to Frith (1985), children go beyond basic letter-sound relations to grasp more sophisticated rules of their written language. This is the "orthographic stage" of spelling development in which children learn higher order rules (Frith, 1985; Marsh et al., 1981). One

very important set of higher order rules is based on morphology and syntax and the term that is usually used to include both of them is grammar.

Beers and Beers (1992) examined the use of inflected endings in children's writing. They used Berko's (1958) paradigm where the child was presented with a picture of a cartoon like person with a pseudoword underneath and asked to generate versions of these pseudowords with morphological endings. The children were in grades one to six and the types of morphologically determined spelling they used were the "s" for plurals, the "ed" for regular past verbs, and the "ing" for the present continuous tense, all of which can be phonetically modified by what precedes the inflectional morpheme. They found that children's ability to use morphological information to generate spellings increased with age. Younger children spelled the endings of the pseudowords phonetically whereas older children used a morphological strategy in spelling.

Nunes Carraher (1985, cited in Bryant, Nunes and Aidinis, 1997) working with Brazilian children also found that children's use of morphological information in their spellings increases with age. In her study children had to spell pseudowords generated from a real stem and a real derivational morpheme. For each pseudoword either the stem or the suffix contained a spelling sequence that could be spelled in two different ways. She found that younger children showed a strong preference for one of the two alternative spelling patterns and used the same spelling irrespective of the morphological interpretation to be assigned to the pseudoword. In contrast, older children used the correct spelling pattern most of the time although no phonological cues to spelling exist in the pseudowords.

Similar results have been obtained by Totereau, Thevenin and Fayol (1997) who studied French speaking children's comprehension and production of the written markers of plural in nouns and verbs. In the first experiment which was designed

to study the acquisition of written French morphology, they gave to 60 seven to nine year old children a production and a comprehension task. In the production task the children had to write the number inflections for the nouns and verbs. All the words were included in sentences or phrases provided to the children and were accompanied by pictures. In the comprehension task the children were presented with two pictures, one of them with one object or person or action and the other one with several objects, persons or actions, and they had to select the one that corresponded to the linguistic item provided with the pictures. Significant age differences were found. Children performed better in the comprehension task than in the production task and better in nouns than in verbs. First and second graders performed very weakly in both comprehension and production tasks.

In order to examine in more detail young children's performance in the task Totereau et al. gave to 272 first and second grade children (6 and 7 years old) the same production tasks and similar comprehension tasks. In the comprehension tasks there were two different terms and only one picture and the children had to match this picture with the relevant linguistic item. All the comprehension items concerned the article + noun or pronoun + verb configurations. The results were similar to those of the first experiment. French children who initially leave out both plural spellings eventually begin to adopt the "s" spelling which they put at the end of plural, and not of singular, nouns. However, they do not get the morphological rationale completely right, for they begin to use the "s" ending for plural third person verbs as well. They have made the right distinction between singular and plural but they ignore the distinction between nouns and verbs. Later on they add "nt" ending to their repertoire but here again they show a remarkable confusion between nouns and verbs. They begin to make the reverse error, giving the plural verb ending to plural nouns. Eventually, both confusions are overcome: the children appear to understand the morphological basis for these different

spellings.

All the above studies indicate that there is a developmental sequence in children's acquisition of spelling strategies. An important question concerns the causes for this later development of morphologically based strategies. There are indications in the literature that some aspects of morphological awareness, usually the easier ones such as the plural inflections to nouns, develop before children enter school while some more complex inflectional forms such as plurals and possessives that involve adding a syllable are learned later on (Berko, 1958). Children's morphological awareness continues to develop as they learn to read and write (Carlisle, 1988; 1995). Studies of the relation between morphological awareness - as measured by morphological recognition and production of morphologically associated words tasks - and spelling show that children's scores on the morphological tasks correlate and predict spelling scores even after controlling for age and vocabulary (Derwing, Smith and Wiebe, 1995; Fowler and Liberman, 1995). The spelling scores used in these correlational analysis, however, were scores of general spelling ability and they did not concentrate on the use of morphological spelling strategies specifically.

More recently, Nunes, Bryant and Bindman (1997a; 1997b) used a longitudinal design to test the hypothesis that there is a developmental sequence in the acquisition of morphological spelling strategies and this development is based on children's morpho-syntactic awareness. They hypothesised three possible reasons for the connection between morphosyntactic awareness and spelling: an internal process, according to which as children develop their knowledge of letter sound correspondences and as they have more experiences with reading and spelling, they realise that there are exceptions and search for an explanation for these exceptions; according to the second hypothesis, the external one, children's learning of morphological based spellings is determined by their level of explicit

awareness of morphological and syntactic distinctions in spoken language; the third hypothesis, the interaction hypothesis, proposes that children need both to reach a certain level of reading and spelling (in order to be able to notice the exceptions) and to reach a certain level of morpho-syntactic awareness (in order to know how to interpret the exceptions).

They followed second, third and fourth grade children for a period of 20 months. They saw the children three times, at the beginning and seven and 20 months after the first session. In all the three sessions they gave children 30 words to spell. Ten of them were regular verbs ending with "ed"; another 10 were irregular verbs and their endings were spelled phonetically; and ten of the words were non-verbs whose final consonant was spelled phonetically. Before spelling the word, children heard a sentence with the word in it in order to understand its meaning. Children in the first session were also tested on three grammatical awareness tasks. The first one was a sentence analogy task where the experimenter, with the help of two puppets, said two similar sentences with a change in the tense of the second sentence. The child then heard a third sentence and he had to make the same change to the tense of the verb of the third sentence as the puppet did to the first. A second test was a word analogy test which was comparable to the sentence analogy but the analogies were between words. The last grammatical test they gave the children was an adaptation of Berko's pseudoword task. All the children were tested on an IQ test and on standardised reading and spelling tests.

They found a sharp increase in the correct use of the "ed" spelling with age. In examining children's errors they found a large number of phonetic transcriptions for the regular past verbs which declined sharply as children grew older. The striking result was that children's generalisations - that is assigning the "ed" spelling to irregular past verbs and to non-verbs - increased with age especially

for the irregular verbs. Based on these results they formed a five stage developmental model for the acquisition of the "ed" spelling. In the first stage, the pre-phonetic, children produce unsystematic spellings of word endings. In stage 2, the phonetic stage, children produce a lot of phonetic transcriptions and not the conventional spelling of morphemes. Children in stage 3 start to produce "ed" endings but they generalise them to irregular past verbs and to non-verbs. In stage 4, children confine "ed" spellings to past verbs with generalisations to irregular past verbs. Finally, in stage 5, children confine the "ed" spellings to the regular past verbs. The relationships between children's age (both chronological and reading) and their allocation to the stages were significant in a positive direction. In a series of multiple regressions they found strong correlations between grammatical awareness (as measured in sentence and word analogy tasks) in the initial session and progress in spelling the "ed" morpheme later. Children's spelling level was also a significant predictor for children's correct spelling of the "ed" morpheme. More importantly, for children at a relatively advanced spelling level, grammatical awareness plays a more significant part.

In order to see whether the conclusions of this study can be generalised Nunes, Bryant and Bindman (1997c, studies 1 & 2) carried out another study similar to the previous one with the difference that children had to spell pseudo-verbs. If children's spellings of the ending of pseudo-verbs follows a similar developmental sequence as their spelling of real verbs then the correct spelling can more confidently be attributed to morphological spelling strategies than to rote learning. In addition they tested whether children's grammatical awareness is related to their spelling of pseudo-verbs and the role of phonological awareness in the learning about this spelling. Finally they examined if children use the strategy of analogy in spelling the endings of regular and irregular words. The children at the beginning of the study were 6,7, and 8 years old and they were followed up for three school years. The children were seen in four sessions, 12,

21 and 33 months after the first session respectively. In the first session children received a word analogy task, in the second session the phoneme oddity task, in the third session a pseudo-verb and a real verb spelling task and in the last session another pseudo-verb spelling task. In the real verb spelling task, children had to spell regular and irregular verbs in the past tense presented orally with the help of sentence context. For the pseudo-verb spelling task in the third session children had to spell the past tense of five regular and five irregular pseudo-verbs, analogous to real verbs. All the pseudo-verbs were presented in the context of a passage which contained two or three instances of the pseudo-verb. Children had a written form of each passage in front of them with the past pseudo-verb missing and they had to write in this missing form. The pseudo-verb task given in the last session was exactly the same but only four regular and four irregular pseudo-verbs were analogous to real verbs while there were another two irregular pseudo-verbs whose stems were not analogous to any real irregular verb.

The results showed an increase in the use of the conventional spelling for the "ed" ending with age. Similarly to the previous study, Nunes et al. found that children's performance in earlier grammatical awareness tasks was related to their use of "ed" in the pseudo-verb task. They also found a second independent link between phonological awareness and growing understanding of the "ed" spelling pattern. So both grammatical and phonological awareness helped children to notice and understand the spelling of past verbs. Lastly another finding is that children learn the distinction between regular and irregular pseudo-verbs either by rule or by analogy to real verbs. The authors conclude that children can learn a highly sophisticated rule (that regular past verbs, which are spelled with ed in the past tense, are the ones in which their present and past tense stems sound the same, while a difference in the pronunciation of the two stems indicates that the verb is irregular and is spelled phonetically in the past tense) without any formal teaching in school. Although Nunes et al.'s studies

revealed very important information for the development of the morphological spelling strategies it was based only on the spelling of one morpheme.

Bryant, Devine, Ledward and Nunes (1997) examined another pattern that depends on morpho-syntactic strategies, namely the use of apostrophes. In a first study they divided 75 year 5, 6, and 7 children into three groups: an experimental group, the children of which received training for the use of apostrophes with genitive nouns; a taught control group which received the same amount of training but was taught to distinguish between homophone words on the basis of their meaning; and an untaught group which received no training. In the pre-test children had to fill in the missing word of a list of 16 sentences which were read out by the experimenter. All the missing words ended either with "-s" (plural) or with "-'s" (singular genitive). In the intervention, children in the experimental group were taught what an apostrophe is, what it looks like and that its use is to denote ownership. In the post-intervention test, children received the same task as in the pre-intervention session. The results showed that all three groups had great difficulty with the apostrophe. Year 6 and 7 children improved after the intervention but not the year 5 children. Surprisingly, the improvement after the intervention was restricted to the use of the apostrophe and not to the correct spelling of the plural. Children even after the intervention continued to use as many apostrophes with plural nouns as they used before the intervention.

In a second study, Bryant et al. (1997) worked with children in the fourth and fifth years of schooling. The children were divided into the same three training groups and received the same spelling task with the addition of eight sentences in which the target word needed an apostrophe because it contained a contraction. Bryant et al. gave also children two metalinguistic tasks, an oddity task and a sentence analogy task, designed to measure their explicit awareness of genitive words and their difference from the plural words. The results showed that

children performed better in the contraction sentences than in the apostrophe sentences. The experimental group of both the Year groups showed a significant improvement in the appropriate use of apostrophes. The number of inappropriate use of apostrophes with plural nouns was significantly lower after training for the older group but not for the younger one. Bryant et al. also found a strong relationship between children's scores in the metalinguistic tasks (only in the sentence analogy task) and their spelling scores for apostrophes. No such relationship was found for the spelling scores for the contraction. As the authors concluded, children's awareness of grammatical distinctions plays a significant role in their learning about apostrophes.

All these studies show that there is a strong relationship between children's grammatical awareness (the term grammatical awareness is used in a broad sense including morphology and syntax (Nunes et al., 1997)), and their use of morphological spelling strategies in spelling. The existence of a developmental model in the acquisition and use of these strategies is well documented by these studies for the English language. It remains to be seen, however, whether this model could equally account for the development of morphological spelling strategies in other languages.

1.VI. Conclusions

A number of studies have been reviewed in this chapter aiming to provide a theoretical framework on which some hypotheses for the development of literacy in Greek can be based. The diversity of languages in which these studies have been carried out strengthens the argument that in order to form a theory of literacy development both the general (characteristics that can be found in a variety of alphabetic scripts) and the specific (characteristics related to the

language in question) features of the language studied must be taken into account. The more important characteristics of the Greek language are the consistent relations between graphemes and phonemes for reading, the existence of one to many correspondences between phonemes and graphemes in spelling and the simple syllabic structure. A very important general characteristic of the Greek language is that both simple and complex rules are involved in reading and spelling implying that literacy acquisition is not an all or nothing process.

Models of fluent reading have demonstrated that skilled readers can read by using both a lexical route and a non-lexical phonological route (Morton and Patterson, 1980). According to developmental models there is a sequence in the acquisition of literacy and this sequence shows a developmental progression (Marsh et al., 1981; Frith, 1985). The core idea in this developmental sequence is that children learn the simple rules first and the more complex ones later. The cognitive strategies that children use in reading and spelling also change in order to be effective for the reading of more complex words.

A common idea in theories of reading development is that beginning readers have only one strategy available, either a visual (Marsh et al., 1981; Frith, 1985) or a phonological (Goswami and Bryant, 1990) one. According to the first view, a phonological strategy is acquired and used at a later stage in development ("sequential decoding" according to Marsh or "alphabetic phase" according to Frith). According to the second view, children, right from the beginning, use their phonological knowledge in reading and the better the child's phonological awareness the better reader s/he will be. Based on the transparency of the Greek language the first hypothesis to be tested in this thesis, is whether Greek children use a phonological strategy in the first stages of reading development. Existing research suggests that a phonological strategy is dominant both at the beginning and at the later stages of literacy acquisition in Greek (Porpodas, 1991; 1993).

A second hypothesis follows from the first. If Greek children use an alphabetic strategy in their reading can all the words be read correctly? In addition, is there any developmental progression in the use of an alphabetic strategy? The Greek language, like many other languages, involves both simple and more complex (hierarchical) phonological rules. According to Marsh (1981) the latter rules are acquired in the last stage of reading development (the orthographic stage) and not in the sequential decoding stage where a phonological strategy is dominant. In contrast, in Frith's theory, all the phonological rules are acquired in the alphabetic phase with simple rules first and more complex later.

An alternative view to the claim that children use only one strategy in the first stages of reading development is that various strategies are available to children in these stages and their use depends on the material they have to read. Tunmer and his colleagues (Tunmer and Chapman, 1995; Tunmer and Hoover, 1992; Tunmer et al., 1988) proposed that children can use contextual cues in reading as an additional help to overcome incomplete graphophonemic information. According to them the use of context is assumed to be a strategy that plays a lesser part in reading as children become better readers. This hypothesis can be formulated in a more general way that increases its power of explanation and adds new possibilities of testing it. In this thesis it is suggested that the use of context to improve accuracy in reading depends both on the skill of the reader and on the difficulty of the word for the reader.

Another strategy that can be used by readers, even young ones, is the ability to make inferences (this strategy has been also termed as analogy) from known spelling patterns with fixed pronunciations in order to read unknown words that share those spelling patterns. On the one hand, children's ability to use this strategy in reading has been explicitly demonstrated in Goswami's experiments (1986, 1988, 1990). On the other hand, according to Marsh (Marsh et al., 1981)

this strategy can only be used spontaneously by children in the last stage of reading development. According to Bruck and Treiman (1992) children's use of this strategy depends on their knowledge of grapheme phoneme correspondences. Children need to know some correspondences between single graphemes and single phonemes in order to make inferences from the pronunciation of known words to the pronunciation of unknown words successfully. The hypothesis that children at various ages make inferences from the pronunciation of known words in order to read unknown words is also tested in the present thesis. It is further hypothesised that this strategy depends on the difficulty of the word to be read and that it improves with age.

Finally, the hypothesis that children learn the simple rules first and the more complex later is also examined in relation to spelling. In Greek, and in many other languages, the application of a phonological strategy will not always result in correct spelling because there are spelling patterns which are determined by morphology in a way that cannot be reduced to phonology. A developmental sequence in the acquisition and use of morphological spelling strategies in English has been proposed by Nunes et al. (1997). According to this view English children start by using phonological strategies in spelling and gradually move on to the use of morphological ones. Nunes et al. also found that children's progress is predicted by their morpho-syntactic awareness. Since in Greek there are instances in which morphemes are the key to deciding between alternative spellings, the hypothesis that a similar model of acquisition of morphological spelling strategies can be identified in Greek is tested in the present thesis.

All these hypotheses were investigated using a number of experiments in which Greek children in the first five grades of the primary school were tested in different tasks involving reading, spelling and morphological awareness.

CHAPTER 2: STUDY 1
THE USE OF PHONOLOGICAL STRATEGIES IN READING GREEK

2.I. Introduction

The aim of this experiment is to test whether reading in Greek develops from simple to complex rules. In English it has been proposed that children go through an "alphabetic stage" first, where they learn the simple rules, before they move to an "orthographic stage" where the more complex rules are learned (Marsh et al., 1981; Frith, 1985; Nunes and Aidinis, 1997).

A number of different strategies have been proposed to be used by children in different stages of reading development (Marsh, Friedman, Welch, and Desberg, 1981; Frith, 1985; Goswami and Bryant, 1990. Many studies in the existing literature, have demonstrated that children in the first stages of reading acquisition rely more on a sequential strategy (see Goswami & Bryant, 1990 for a review). There is also evidence that children can use conditional rules effectively only in the last stages of reading development (Marsh et al., 1980; Goswami & Bryant, 1990).

The strategies that children use in reading are related to the difficulty of the words to be read. Using a phonological strategy, for example, can result in correct reading of words that involve constant or variable but predictable spelling patterns while the same strategy is of little use in reading words that involve variable unpredictable spelling patterns. It is clear then, that alphabetic scripts that have constant relations between graphemes and phonemes require simple strategies for reading while alphabetic scripts with variable relations between graphemes and phonemes require the use of more complex strategies.

As Treiman (1993) points out "the ideal alphabet, it is often thought, has one-to-one

relations between phonemes and graphemes" (p. 22). English appears to have one-to-many relations between graphemes and phonemes and also from phonemes to graphemes. In other words, one phoneme can be represented by more than one grapheme and one grapheme can represent more than one phoneme.

There are suggestions in the literature that the English writing system is complex and irregular (Treiman, 1993). As a result of the complexity and irregularity, the English writing system is very difficult for children to learn. According to that argument, difficulties in learning to read and write result from the irregularities of the system. So, the argument goes, if the system was a regular one then children would learn to read and write more rapidly and with more ease (Treiman, 1993). Hence, if we could find an alphabetical writing system which is more regular than the English one, we would expect that children learning to read and write in that system would have fewer difficulties and would learn more easily.

The very fact of the existence of one-to-many relations between phonemes and graphemes does not make a group of words irregular. For example, if the phoneme /a/ is spelled as "a" in some words and as "u" in others, and there is a rule which says that at the beginning of words the phoneme /a / is spelled with "a" and at the end of words is spelled with "u", then a child who knows the rule can read or write any word that contains this phoneme. In this sense, irregular words could be characterised as those that violate the rule and they have "u" at the beginning (Treiman, 1993).

According to Treiman's argument, only the words that violate grammatical rules could be characterised as irregular. That does not mean that all regular words pose the same difficulty in reading. A further segregation of these regular words may exist. To illustrate that further, these words can be divided into three groups. The first one is the group that has one-to-one constant relations between graphemes and

phonemes. These words can easily be read using a simple sequential strategy; you simply read what you see. A second group is the words that have two-to-one constant relations between graphemes and phonemes. In this category belong the digraphs and the double letters. A sequential strategy can be applied in reading of these words too, since the two letters of the digraph always represent the same phoneme. The last category is made up of words that have one-to-one relations between graphemes and phonemes, but these relations are variable. In this category belong the words whose reading depends on conditional rules. Although a sequential strategy could be applied to these words, the reader must know the importance of the following letter in determining the pronunciation of the previous ones. A similar discrimination between different spelling patterns (invariant and variant-predictable), for the English language, has been made by Venezky (1995). Significant differences between reading words that involve constant spelling patterns and words that involve variant but predictable spelling patterns have been reported by Rack et al. (1994).

As far as reading is concerned, it could be said that the Greek language is quite regular. Although there are exceptions to the one-to-one relations between graphemes and phonemes, there is always a rule that makes the reading of those exceptions totally predictable. Consequently, according to Treiman's argument, it can be claimed that the Greek language has no irregular words; although some words violate the one-to-one relations they may not be more difficult to read. Three classes of words exist in Greek: a) words with constant one-to-one correspondence between graphemes and phonemes; b) words with constant two-to-one correspondence between graphemes and phonemes; and c) words with variable one-to-one correspondence between graphemes and phonemes. Given that Greek has a more transparent orthography than English but still involves variable but predictable spelling patterns, a question to be asked in this experiment is whether a developmental model from simple to complex will still hold for reading acquisition in Greek.

A second question has to do with the strategies that Greek children use in the first stage of their development. Do they start by using a simple sequential strategy and later develop more complex strategies? An alternative hypothesis might be that Greek children are using both simple and complex strategies right from the beginning of their reading development. If we assume that children use a grapheme-phoneme sequential strategy for all words, do they read words that violate the constant relation between graphemes and phonemes correctly? For example, words with digraphs or double letters and words that involve conditional rules, although they can be read on the basis of a phonological strategy, might be more difficult because, in the first case the reader must know that two consecutive letters represent one phoneme, and in the second case the reader must know that the pronunciation of a letter depends on the letter that follows.

A logical argument for words involving digraphs and conditional rules could be that they are of the same difficulty since the following letter determines the pronunciation of the previous one. For example, the letter "μ" represents the phoneme /m/ when it appears alone in a word. When the same letter is followed by the letter "π" which represents the phoneme /p/ then the two letters represent the phoneme /b/. Similarly, one could say, in the case of the "αυ" combination, the letter "υ" is pronounced /f/ if it followed by certain letters and /v/ if is followed by others.

There are two major differences between the two cases. Firstly, in the case of a digraph both letters change pronunciation and instead of two phonemes they represent one. Thus, a digraph could be regarded as one letter. On the other hand, in the case of a conditional rule only the pronunciation of one letter is changed depending on the following letter. Secondly, there is a constant relation between the two letters of a digraph and the phoneme that they represent (e.g. "μπ" is always pronounced as /b/), whereas in a conditional rule there is variable relation between the letter and the phoneme that this letter represents depending on the following

letter (e.g. "αυ" is pronounced as /af/ when is followed by "τ" or as /av/ when is followed by "λ").

According to Marsh et al. (1981), in English conditional rules are acquired during the last stage of reading development. Marsh et al. have reached this conclusion by studying different conditional rules (e.g. the final e, the C etc.) It is possible, that children do not acquire all the conditional rules at the same time. Some conditional rules might be more difficult than others. In Greek there are three different conditional rules. Do Greek children master these rules at the same time?

English-speaking children in the first stage of reading acquisition rely on phonological units bigger than phonemes, such as onset and rime (Goswami and Bryant, 1990; Bradley and Bryant, 1983; Bryant et al., 1989, 1990a, 1990b). Along similar lines, Aidinis and Nunes (1997) found that Greek-speaking children use both phonemes and syllables when they read. Do Greek children rely on bigger phonological units at the beginning of their reading development? If this hypothesis is correct, does the structure of the syllable make the reading of the words harder? Do more complex syllables pose more difficulty for children's reading?

Greek contains many common, long words. Does the length of the words influence children's reading? Another question has to do with frequency. What is the effect of frequency on the reading of different words? Do Greek children read with the same ease words which they have seen many times and words which appear only a few times in their books? Lastly, is there any difference between real words and non-words? On the one hand, if children are asked to read only real words, there is a possibility that they might have seen these words and have memorised their pronunciation. On the other hand, by using non-words the only way for children to figure out their pronunciation is to use a phonological strategy. Hence, the reading of non-words is a purer measure of the strategies that children use when they are

reading. As Marsh et al. (1980) point out "in order to assess different strategies, it is desirable to design the pseudowords so that alternative responses are indicative of the use of a particular strategy" (p. 341).

The hypothesis to be tested in this experiment is that Greek children at the beginning of their reading development use a simple sequential strategy before they learn more complex phonological strategies. I expect children's performance to vary as a function of the classes to which words belong and the age of the children.

2.II. Method

2.II.a. Participants

104 children participated in the study (50 girls, 52 boys), equally divided between three age groups: 6 years old (ranging from 6 years 1 month to 7 years, with mean age 6 years and 6 months), 7 years old (ranging from 7 years 1 month to 8 years, with mean age 7 years 5 months), and 8 years old (ranging from 8 years 1 month to 9 years, with mean age 8 years 6 months). The three groups were in 1st grade, 2nd grade, and 3rd grade respectively. They were attending four different public schools in the city of Katerini, in Northern Greece. Subjects were selected randomly from the register list. The teacher of each class was asked to exclude from the list the children who had a serious problem with reading. Six children (all of them in the first grade) were excluded from the study because they could not recognise all the letters of the alphabet.

2.II.b. Reading and spelling instruction in Greek

Because instruction may influence the way in which reading is acquired in Greek, a

brief description of reading instruction will be presented. The vast majority of the children begin school at the age of five in kindergarten. Some children attend public or private nursery schools before that. Reading and spelling are not included among the activities for kindergarten children.

Compulsory education starts in first grade. All children receive the same reading books from the government, free of charge. Although teachers can develop their techniques to complement the use of the readers, much of the work done in the classroom is influenced by what is contained in them. In the first half of the first year children are taught the sounds and names of letters in the context of short words and phrases. An example of a lesson is presented in Figure 2.1, where the letter μ (m) was being introduced. It can easily be seen that children are taught to divide words into syllables and phonemes and then reassemble them.

The method of instruction thus relies on two levels of analysis, the syllable and the phoneme. This form of instruction could therefore lead children to use both syllabic and phonemic strategies in reading and result in a differentiation of word classes as a function of the type of syllables present in the word -- that is, words containing the simplest syllables (e.g. CV, V) may be easier to read than those that include more complex syllables (e.g. CVC, CCV, CCCV etc.).

In the second half of first grade children are exposed to reading and writing text and by the end of the year they are expected to read a text of over a hundred words.

2.II.c. Design

In order to test the above hypotheses, words from three different classes in terms of the relations between graphemes and phonemes were used. Because frequency has


IMAGE REDACTED DUE TO THIRD PARTY RIGHTS OR OTHER LEGAL ISSUES

been found to have a significant effect on reading, the first concern was to determine the frequency for each word. The frequencies of the words came from the reading books of the first three grades. Every word from all the books was entered into the computer; at the end frequency tables for each word in the list were produced, separately for each grade. A word was counted as frequent when it appeared more than ten times in the books, and as infrequent when it appeared once or twice in the reading books. A total of 126 words, 42 for each class, half frequent and half not frequent were selected. These words allow us to see the differences in the level of difficulty between the three classes of words, as a result of the use of a sequential strategy, and the effect of word frequency on reading.

Differences within the classes of words were included to control for other variables that might influence children's reading. Word length was controlled in the words that involve one-to-one constant relations between graphemes and phonemes. In order to be certain that it is word length that influences children's reading, word length must be the only factor that differentiates the words and only words with one-to-one constant relations between graphemes and phonemes allow for this kind of control.

The structure of the syllable was also controlled in both words with one-to-one constant relations and two-to-one constant relations between graphemes and phonemes. Simple CV syllables might be easier than more complex CCV or CCCV syllables. If children rely on phonological units bigger than phonemes in their reading then a difference between the words with simple syllables and those with more complex syllables would be found.

The second step was to generate non-words. Non words were prepared which, like the words, were divided between three different classes (making a total of 63 non-words). Non-words were created to look like real Greek words, i.e. to have the

endings, the syllables and the clusters of letters that are found in Greek. There were no real words that matched the pronunciation and the appearance of the non-words. By having non words for each category the hypothesis that Greek children use a sequential strategy in reading rather than simple visual recognition can be tested. If children' s performance in non words is the same as in words then we may conclude that they use a sequential strategy.

Each child was seen in one session and asked to read a total of 189 words and non-words randomly presented in a list. Table 2.1 summarises the design; there were 27 cells with 7 words per cell.

2.II.d. Materials and Procedure

All children, individually interviewed in a separate room within their school, were given the same list of words. There were 63 non-words randomly mixed with the 126 words. The children were asked to read aloud all the words in the list. Before beginning to read the words, the child was told that some of the words were easy to read but some of them were really very hard, even for older people. They were also told that some of the words were not real ones and that is why they did not make sense. There was no early discontinuation and all the children read all the 189 words. One child from the first grade who refused to read all the words was excluded from the study.

a) One-to-one constant relations words. These words and non-words were equally divided into three groups: short words with simple syllables, long words with simple syllables and words with complex syllables (both short and long words were included in this group).

Table 2.1

Design of Experiment 1

Word Categories		Words		Non-Words
		Frequent	Not-Frequent	
A. One -to-One Constant Relations	Simple Syllable Short	7*	7	7
	Simple Syllable Long	7	7	7
	Complex syllable	7	7	7
B. Two-to-One Constant Relations	Digraph	7	7	7
	Digraph plus Consonant	7	7	7
	Double Letter	7	7	7
	αυ-ευ Combination	7	7	7
C. One-to-One Variable Relations	Vowel Cluster Stress	7	7	7
	Vowel Cluster Dialitika	7	7	7

* Number of words used for each group

b) Two-to-one constant relations words. These words and non-words were divided into three groups: words with digraphs and simple syllables; words with digraphs followed by a consonant which consequently had complex syllables; and words with double letters.

c) One-to-one variable relations words. These words and non-words were divided into three different groups according to the conditional rule involved: the first group included words that involved the αυ-ευ combinations; the second group included words that involved the conditional rule where two vowels are pronounced separately because of the stress mark; and the third group included words where two vowels are pronounced separately because of a diacritical mark called dialitika (all these conditional rules have been explained in a previous chapter).

Words were written in lower case, in font size 16 and were presented on A4 paper, fifteen per page (the list of the words to be read is presented in Appendix 1). The procedure lasted from 10 to 20 minutes for each child and all the interviews were tape recorded. During the interview the experimenter had a different sheet, similar to the one that the child had, and he marked the mistakes that the child made, out of the sight of the child.

2.III. Results

The results are described in four sections. The first section describes the coding procedure and the children's performance on the task. The second section focuses on the question of whether children start reading using simple phonological strategies before they use more complex strategies by comparing children's performance for different classes of words that require the use of different strategies. In the third section factors that influence children's reading are considered. The last section focuses on the question of whether children master all the conditional rules at the

same time, by comparing their performance on the three conditional rules.

2.III.a. Descriptive statistics

The data obtained were coded separately for each word as correct (1) or wrong (0). A third category was concerned with the cases when the children read the word wrongly but then corrected themselves and read the word correctly. These cases were coded as 2. An intermediate solution was to give half a point to these cases. However, the same analyses were performed three times (a: the 2s were recoded as 0, b: the 2s were recoded as 1, and c: the 2s were recoded as .5). All three ways of analysis produced similar results. In the analyses that follows the results of the intermediate solution (when 2s were coded as .5) are presented.

Cronbach's Alpha for item analysis on additive scale reliability analysis was performed for all the words in the scale. The analysis revealed that, except for some one-to-one constant relation words in which there was no variance, all the other words were highly reliable (Alpha > .96).

Mean scores, frequencies and distributions were examined. The mean scores and standard deviations are presented in Table 2.2. Figure 2.2 presents the distribution of scores in the three categories of words. The mean scores presented in Table 2.2 show that children had little or no difficulty in reading the words that have constant relations between graphemes and phonemes, despite the fact that the two-to-one constant relations class of words violated the one letter for one sound rule. On the other hand, words with variable relations between graphemes and phonemes pose great difficulty for children's reading.

Table 2.2

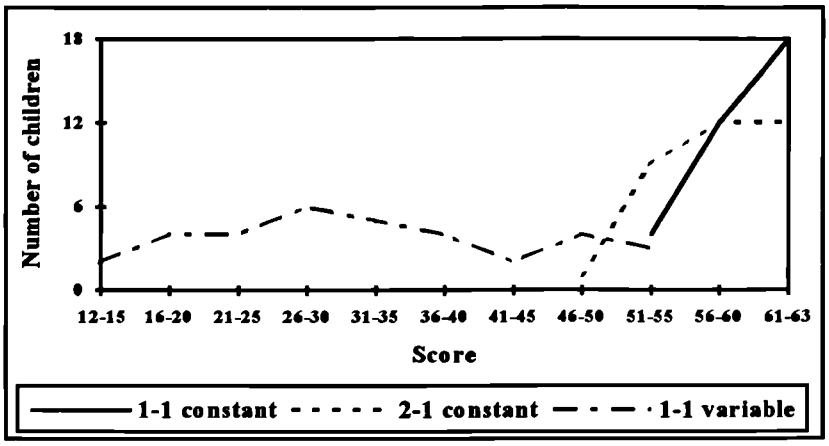
Means and Standard Deviations for the Three Categories of Words

	Words		Non-Words
	Frequent	Not-Frequent	
One-to-One (1-1)	20.90	20.20	20.30
Constant	(.33)*	(.94)	(1.20)
Two-to-one (2-1)	20.80	20.40	19.40
Constant	(.55)	(1.15)	(2.00)
One-to-one (1-1)	18.60	14.50	11.70
Variable	(4.00)	(4.72)	(4.87)

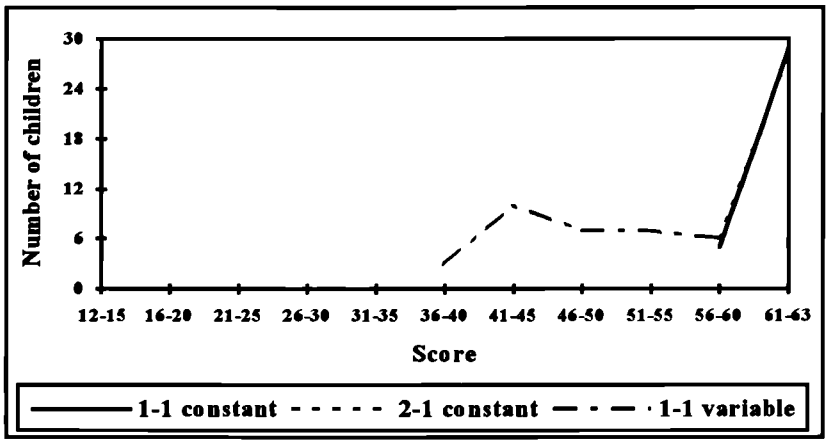
* Standard Deviation in brackets

Maximum score = 21 for each variable

Grade 1 (6 years old)



Grade 2 (7 years old)



Grade 3 (8 years old)

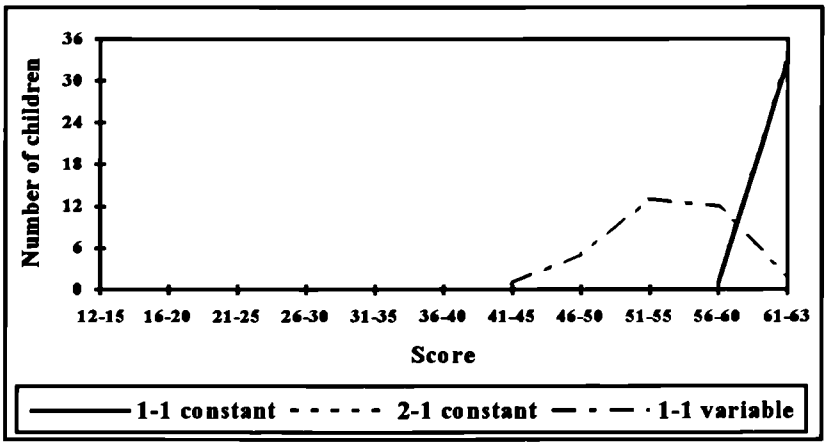


Figure 2.2
Frequency distribution of scores for each class of words
N=34 for each grade; Maximum score= 63

The differences between the mean scores were analysed using Anovas with repeated measures across groups of words and age as the between factor. One variable (total score in frequent simple syllable short words) had no variance and instead of Analysis of Variance, Friedman's test for k correlated samples was used in the analyses where this variable was involved.

2.III.b. Do Greek children develop their reading ability from simple to complex rules?

It was hypothesised that Greek children start reading by using a simple phonological strategy and as they get older and improve their phonological skills they start to use more complex strategies. It was expected that there would be significant differences between children's performance in words of different classes. It was also expected that these differences would decrease with age. As described earlier, three categories of words can be found in Greek: a) those that have one-to-one constant relations between graphemes and phonemes (1-1 Constant); b) those that have two-to-one constant relations between graphemes and phonemes (2-1 Constant); and c) those that have one-to-one variable relations between phonemes and graphemes (1-1 Variable).

The prediction was that 1-1 constant words would be easier than 2-1 constant; the latter type of words was in turn predicted to be easier than 1-1 variable words. Assuming that children use a sequential strategy, it was expected that the words that violate the one-to-one correspondence or have variable relations between graphemes and phonemes would be harder for children. Lastly, if children rely only on a phonological strategy we would not expect to find any significant effect for frequency. In other words, if this hypothesis is correct, then we do not expect any differences between frequent, not-frequent and non-words, or a decrease in these differences, as children get older.

The number of correct responses was subjected to a mixed Analysis of Variance, in which the age (3: 6 year-olds, 7 year-olds, 8 year-olds) was the between subjects factor, and the type of words (3: 1-1 Constant, 2-1 Constant, and 1-1 variable) and the frequency (3: frequent, not-frequent, non-words) were the within-subjects factors. Mean scores for the three age groups are presented in Figure 2.3. As can be seen children's performance improves with age especially for the one-to-one variable words. Figure 2.4 presents the mean scores for each of the classes of words in relation to age and frequency of the words. As can be seen, not-frequent words and non-words are more difficult than frequent words but only for younger children and words that belong to the one-to-one variable class.

The main factor of age was significant ($F(2,99)=57.27$, $p<.001$). A subsequent post hoc (Newman Keuls) test revealed that all the comparisons were significant ($p<.001$). The type of words factor was also significant ($F(2,198)=350.52$, $p<.001$). Post hoc (Newman Keuls) test showed that all the contrasts were significant ($p<.001$). The two-way interaction, age by type of words was significant ($F(4,198)=35.54$, $p<.001$). Lastly, the analysis produced a significant effect for the frequency factor ($F(2,198)=326.24$, $p<.001$). As a Newman Keuls test established, all the comparisons were significant. The interaction between age and frequency was significant ($F(4,198)=11.01$, $p<.001$). Similarly, the two-way interaction between type of words and frequency was significant ($F(4,396)=209.99$, $p<.001$). The three-way interaction was also significant ($F(8,396)=2.11$, $p<.05$).

Figure 2.3 shows that, although there is a significant difference between all three age groups, the difference between the performance of the second and third graders is rather small. The only age group that has a clear difference from the others is the first graders. It is worth noting, as can be seen from figure 2.4, that almost all children performed at ceiling level for certain groups of words, e.g. frequent 1-1

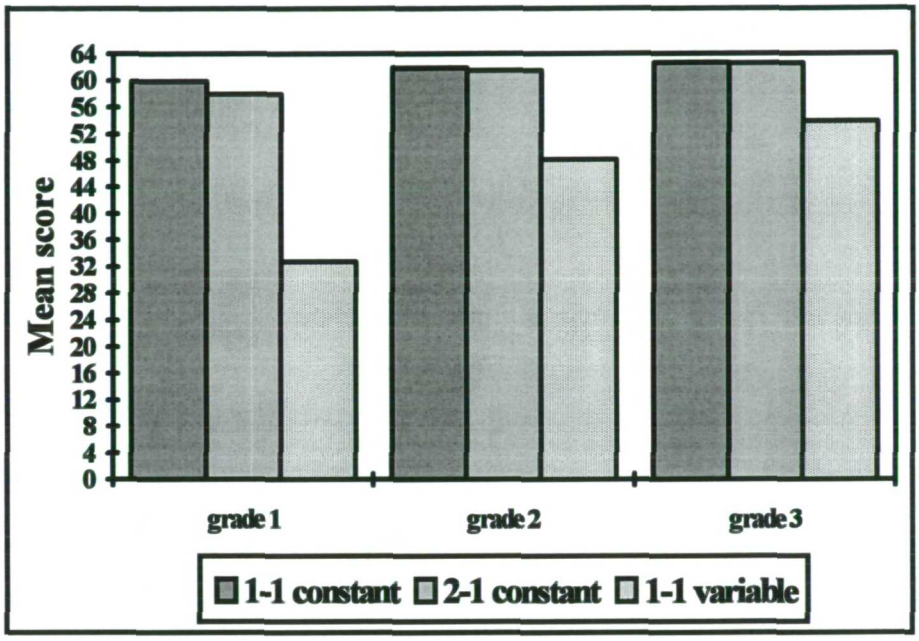


Figure 2.3
Mean no. of words read correctly by word class and age group
Maximum score = 63

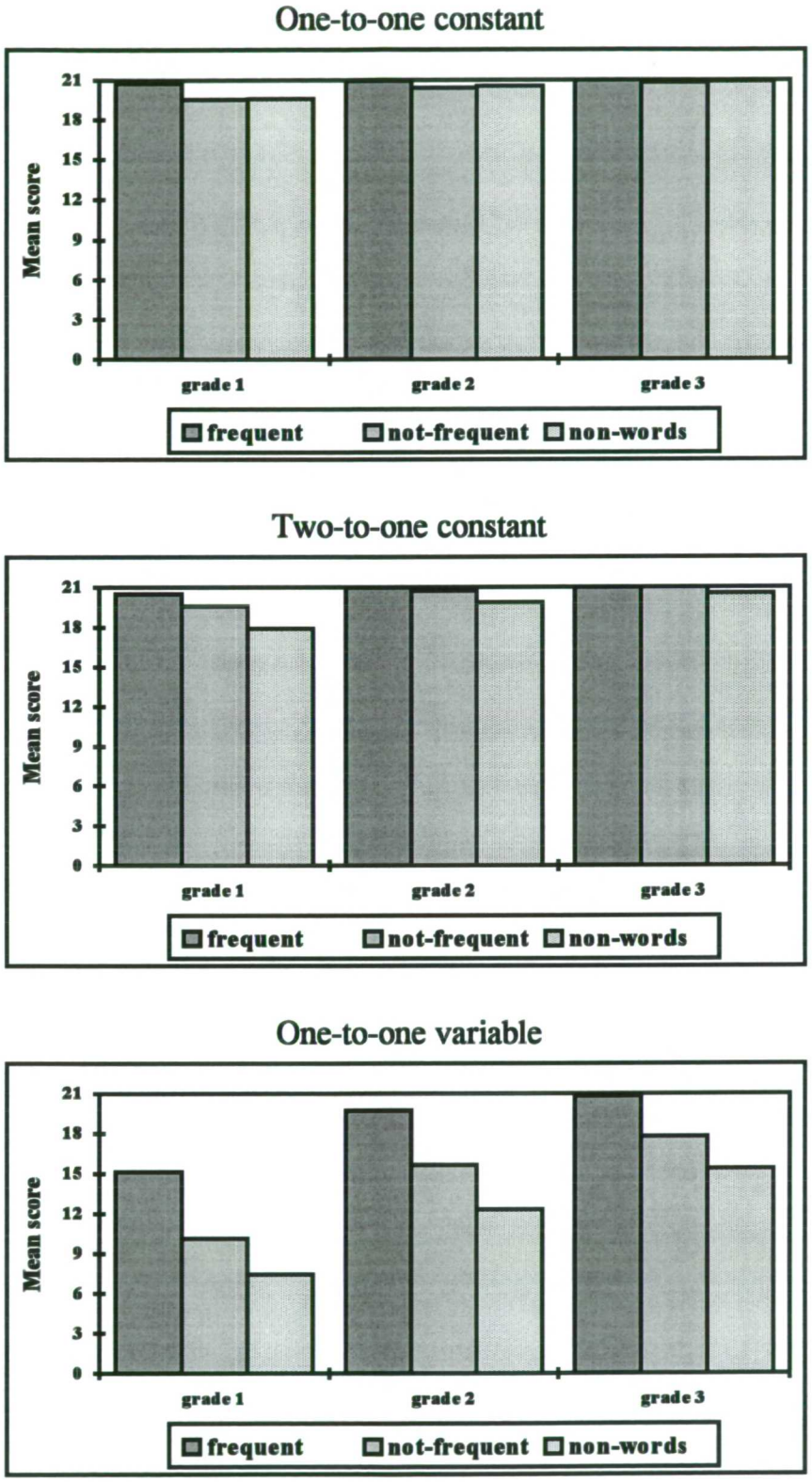


Figure 2.4

Mean no. of words read correctly by age and frequency in the three classes of words

Maximum score = 21

constant, frequent 2-1 constant[1]. Lastly, it is important to note that all the age groups - and especially the first graders - performed poorly in the category of one-to-one variable relations words.

In brief, reading words in which there are one-to-one constant relations between graphemes and phonemes is easier than reading words that violate the one-to-one relation or words whose reading depends on contextual rules. Frequency was found to have a significant effect on children's reading, and non-words were found to be harder than words (frequent or not). Significant age differences were found showing that there is a developmental sequence in the acquisition of reading. As it was hypothesised, Greek children use a sequential strategy in the first stage of reading development. It was predicted that the use of a sequential strategy will result in more incorrect reading of the two-to-one constant and one-to-one variable relations categories of words. This was confirmed by the significant differences between the three categories of words. These results also confirmed the hypothesis that reading develops from simple to complex rules. As children get older and develop their phonological skills they master more complex rules and they can read more difficult words. The small, although significant, differences between one-to-one and two-to-one constant relations categories of words, indicate that children even from the age of six have the ability to read words that involve digraphs and double letters.

Children's performance in not-frequent and non-words is a clearer indicator of the use of a sequential strategy. Children from all the age groups read most of the not-frequent words and the non-words correctly. The differences between frequent, not-frequent and non-word items were smaller for the categories of words that have constant relations between graphemes and phonemes, and they waned as children get older. Thus it can be concluded that as children get older they can use more complex phonological strategies.

---

[1] There was no significant difference between these two groups of words.

2.III.c. Does Word Length and Complexity of Syllable Influence Reading?

It was hypothesised that Greek children at the beginning of their reading development rely on larger phonological units than phonemes, such as syllables (Aidinis and Nunes, 1997). In Greek there are several types of syllable (e.g. V, CV, CCV, CCCV, CCVC etc.) and some of them (e.g. CV) can be characterised as more complex than others (e.g. CCCV). Therefore, it was predicted that words with more complex syllables will be more difficult than words with simpler syllable types.

It was also hypothesised that word length influences children's performance in reading. It is known that short term memory influences children's performance in phonological oddity tasks but that the memory demands do not explain all the variance which such tasks have in common with reading and spelling (see, for example, Oakhill, Cain and Bryant, 1997). The prediction was that long words would be more difficult to read than short words.

In order to test the above hypotheses two different sets of analyses were carried out. The first one dealt with the effect of word length and complexity of syllable on children's performance in the one-to-one constant relations class of words. The second set of analyses considered the effect of the complexity of the syllable on children's performance in the two-to-one constant relations class of words and if there are any differences between words that involve digraphs and words that involve double letters. Because in the previous analysis frequency was found to influence children's reading it was also included in these analyses.

2.III.c.i. Effects of word length and complexity of the syllable on children's performance in the one-to-one constant relations class of words

Three subgroups of words that involve one-to-one constant relations were defined:

one-to-one constant relations simple (words with CV or V syllables but no more than three syllables); one-to-one constant relations long (words with CV or V syllables but with more than three syllables); and one-to-one constant relations complex (words with consonant clusters). For each of the subgroups of one-to-one constant relations words there were three subcategories: frequent, not-frequent, and non-words.

The total numbers of correct answers were subjected to an 3 X 3 X 3 Analysis of Variance in which the main factors were age (3: 6 year olds, 7 year olds, and 8 year olds), group of words (3: 1-1 constant simple, 1-1 constant long, and 1-1 constant complex), and frequency (3: frequent, not-frequent and non-words), with repeated measures on the second and third factors. Mean scores are presented in Table 2.3. As can be seen from this table, children performed at ceiling levels on the words that involved simple syllables irrespective of length. By contrast, children performed slightly worse on the words that involved complex syllables.

The main term of age was significant ($F(2,99)=22.56$, $p<.001$). Post hoc (Newman-Keuls) tests revealed that all the comparisons were significant ($p<.001$). Age differences can be seen in Figure 2.5. As Figure 2.5 shows, the age differences, although significant, are very small. The analysis produced a significant difference between the three groups of one-to-one constant relations category of words ($F(2,198)=84.95$, $p<.001$) (see Figure 2.6). Post hoc (Newman-Keuls) tests established that this difference was due to the children performing significantly worse in 1-1 constant complex words ($p<.001$) than in 1-1 simple and 1-1 complex groups of words. The interaction between age and group of words was significant ($F(4,198)=24.65$, $p<.001$). The frequency factor was also significant ($F(2,98)=30.48$, $p<.001$) (see Figure 2.6). As post hoc (Newman Keuls) tests showed, children performed significantly better on frequent words than on both not frequent words and non words ($p<.001$) while there was no significant difference between not-

Table 2.3

Means and Standard Deviations for the subgroups of the one-to-one constant relations class of words

		Words		Non-Words
		Frequent	Not-Frequent	
.	Simple Syllable	7.00	6.98	7.00
	Short	(0.00)*	(.14)	(.20)
One-to-One				
Constant	Simple Syllable	6.99	6.99	6.98
Relations	Long	(.10)	(.10)	(.14)
	Complex Syllable	6.91	6.30	6.40
		(.32)	(.88)	(1.07)

* Standard Deviation in brackets

maximum score=7 for each variable

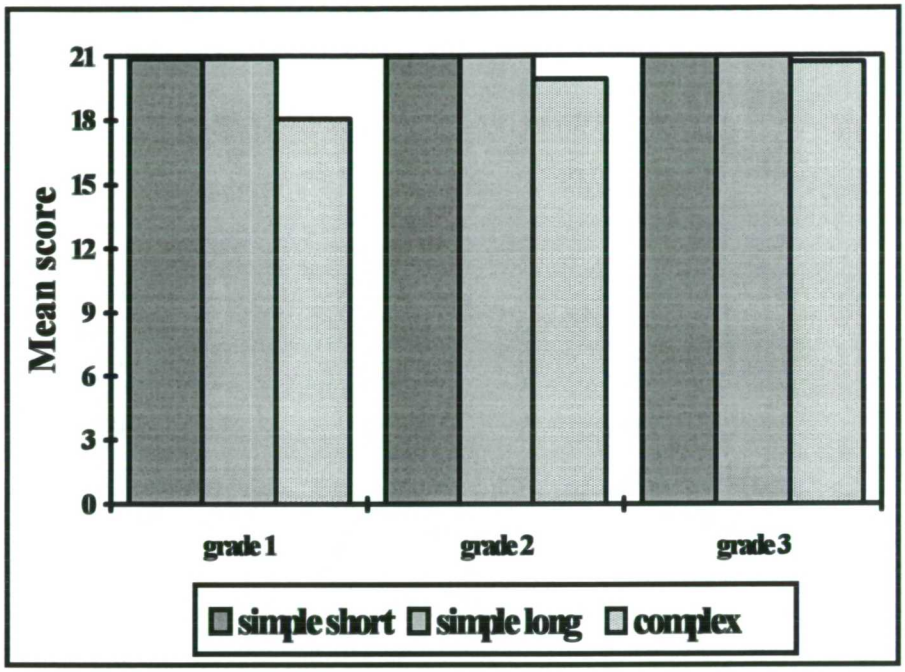
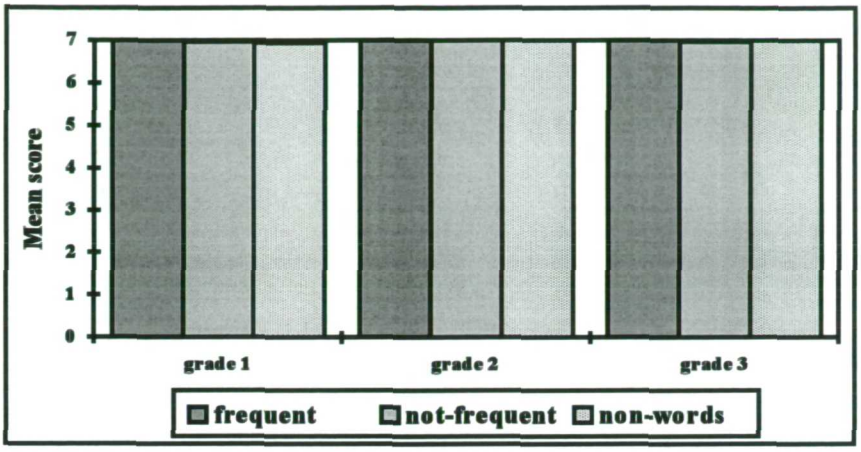


Figure 2.5

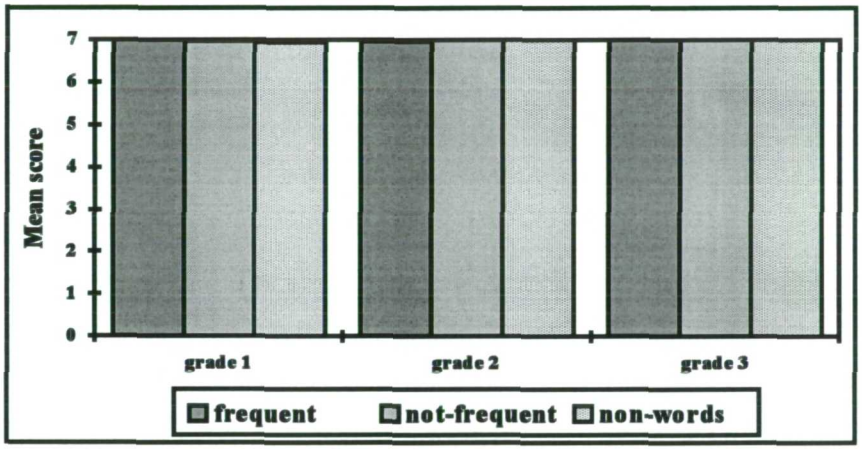
Mean scores of words read correctly by age and group of words for one-to-one constant relations class of words

Maximum score = 21

simple syllable short



simple syllable long



complex syllable

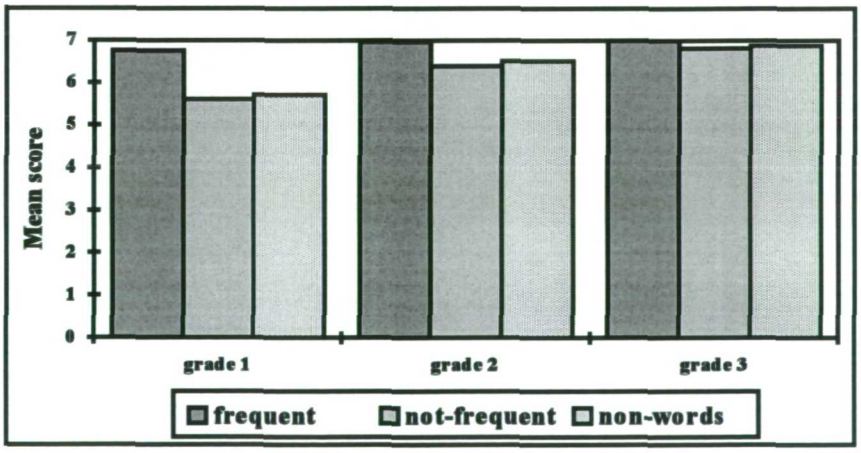


Figure 2.6
Mean score of words read correctly by age and frequency for the groups of one-to-one constant relations words
Maximum score = 7

frequent words and non-words[1]. The two-way interactions between age and frequency, and between group of words and frequency were also significant ($F(4,198)=7.56$, $p<.001$ & $F(4,396)=31.37$, $p<.001$, respectively). The three way interaction, age by group of words by frequency, was also significant ($F(8,396)=6.74$, $p<.001$).

The above results can be seen more clearly in Figure 2.6. This figure shows that from the one-to-one constant relations category of words, only the words with complex syllables posed some difficulty in reading. The fact that children performed almost at ceiling level in this category of words (even for the complex syllable group the mean was about 6 for not-frequent words and non-words while the maximum score was 7) shows that when one-to-one constant relations between graphemes and phonemes are applicable, then the reading of these words is an easy task for children, even for those who are in first grade and have just learned how to read.

In summary, the results revealed that the length of word by itself has no effect on children's reading. This was true for all frequent words, not-frequent words, and non-words. It was also found that words or non-words which contain more complex syllable types (such as consonant clusters) are harder to read than words with simple syllables, especially for the younger children. At least in the first stages of reading development, children rely on larger phonological units than phonemes. Frequency had an effect on children's reading but only for the complex syllable words. Lastly, there was no significant difference between not-frequent words and non-words.

[1] Subsequent analyses showed that there were no significant differences between frequent words, not frequent words, and non-words for the simple syllable short and the simple syllable long subcategories of the one-to-one constant relations category of words.

2.III.c.ii. Effects of the complexity of the syllable on children's performance in the two-to-one constant relations class of words

Differences between the groups of two-to-one constant relations category of words are examined in this section. Three different groups of two-to-one constant relations class of words have been identified: two-to-one digraph (words that involve digraphs); two-to-one complex syllable (words that involve a digraph that is followed by a consonant); and two-to-one double letter (words that involve double letters). As in the previous analysis, a difference between words that have consonantal clusters (a digraph plus a consonant) and those without consonantal clusters was predicted, because in the former, more complex syllables are involved. Secondly, a difference between the words that involve digraphs and the words that involve double letters is predicted. This results from the fact that in the case of the digraphs the two letters of the digraph represent a different phoneme when they appear separately compared with when they appear together, while a double letter represents the same phoneme which the two letters represent when they appear separately. Because frequency was found in the previous analyses to influence children's performance it was also included in this analysis.

The number of correct responses was subjected to a mixed model Analysis of Variance in which age (3: 6 year-olds, 7 year-olds, and 8 year-olds) was the between subjects factor, and the group of words (3: words containing respectively a digraph, a complex syllable (a digraph followed by a consonant), and double letter) and frequency (3: frequent words, not-frequent words, non-words) were the within subjects factors. Means are presented in Table 2.4. As we can see from this Table there are no large differences between the mean scores of the three different groups of words.

Table 2.4

Means and Standard Deviations for the subgroups of the two-to-one constant relations class of words

		Words		Non-Words
		Frequent	Not-Frequent	
Two-to-one Constant Relations	Digraph	6.99	6.94	6.82
		(.10)	(.24)	(.41)
	Complex syllable	6.90	6.60	6.00
		(.43)	(.96)	(1.59)
	Double Letter	6.95	6.90	6.60
		(.22)	(.45)	(.64)

* Standard Deviation in brackets

maximum score=7 for each variable

The main term of age was significant ($F(2,99)=26.18$, $p<.001$). Figure 2.7 shows the age differences in children's performance. A subsequent post hoc (Newman-Keuls) test showed that all the comparisons were significant ($p<.005$). The analysis revealed a significant effect for the group of word factor ($F(2,198)=24.53$, $p<.001$). Post hoc (Newman-Keuls) test showed that all the contrasts were significant[1] (see Figure 2.8). The interaction between age and group of words was also significant ($F(4,198)=13.13$, $p<.001$). The frequency factor was significant ($F(2,198)=66.91$, $p<.001$). Post-hoc (Newman Keuls) test showed that all the comparisons were significant ($p<.001$)[2]. The two-way interactions, age by frequency, and group of words by frequency, were significant ($F(4,198)=13.33$, $p<.001$ & $F(4,396)=10,87$, $p<.001$ respectively). Lastly, the three-way interaction, age by group of words by frequency, was also significant ($F(8,396)=4.88$, $p<.001$).

In brief, the results for the two-to-one constant relations category of words showed that words which contain a consonant digraph followed by a consonant are significantly more difficult for children to read than words with digraphs or double letters. In general, frequent words are easier than non-words but the difference between frequent and not frequent words was only significant when difficult words were involved. By looking at Figure 2.8 we can see that the only group in which children performed worse was the group of words that contain complex syllables (a digraph followed by a consonant). These results replicated and reinforced those for the one-to-one constant relations category of words, confirming that Greek children in the first stages of reading development rely on phonological units larger than phonemes. The structure of the syllable seems to play a very important role in the first stage of reading development. The results also showed that there are no significant differences between words that involve digraphs and those that involve

[1] Further analyses showed that there was no significant differences between frequent digraph and frequent double letter words as well as between not-frequent digraph and not-frequent double letter words.

[2] Subsequent analyses revealed that there was no significant differences between frequent and not frequent words for both the digraph and the double letter groups of words.

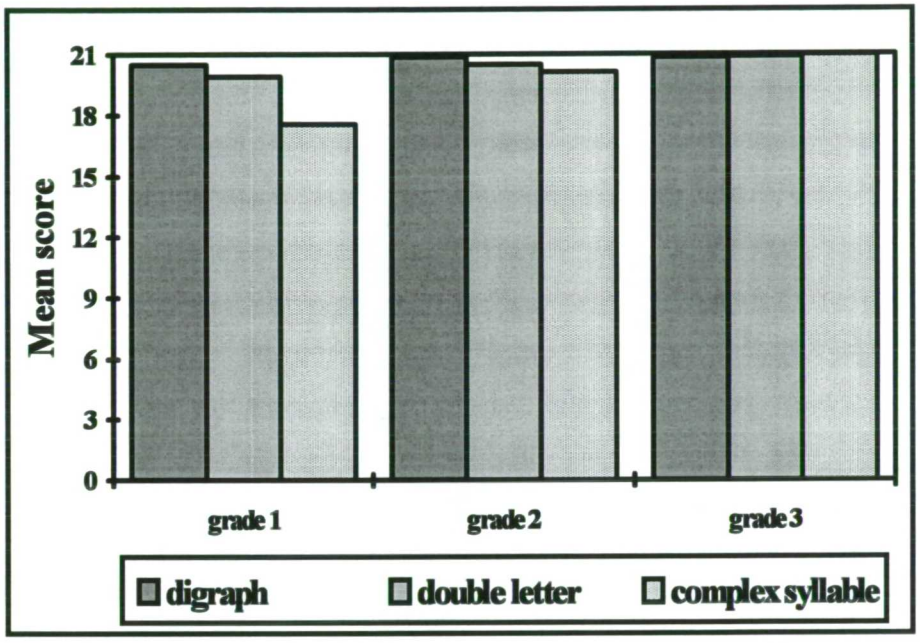


Figure 2.7

Mean scores of words read correctly by age and group of words for two-to-one constant relations class of words

Maximum score = 21

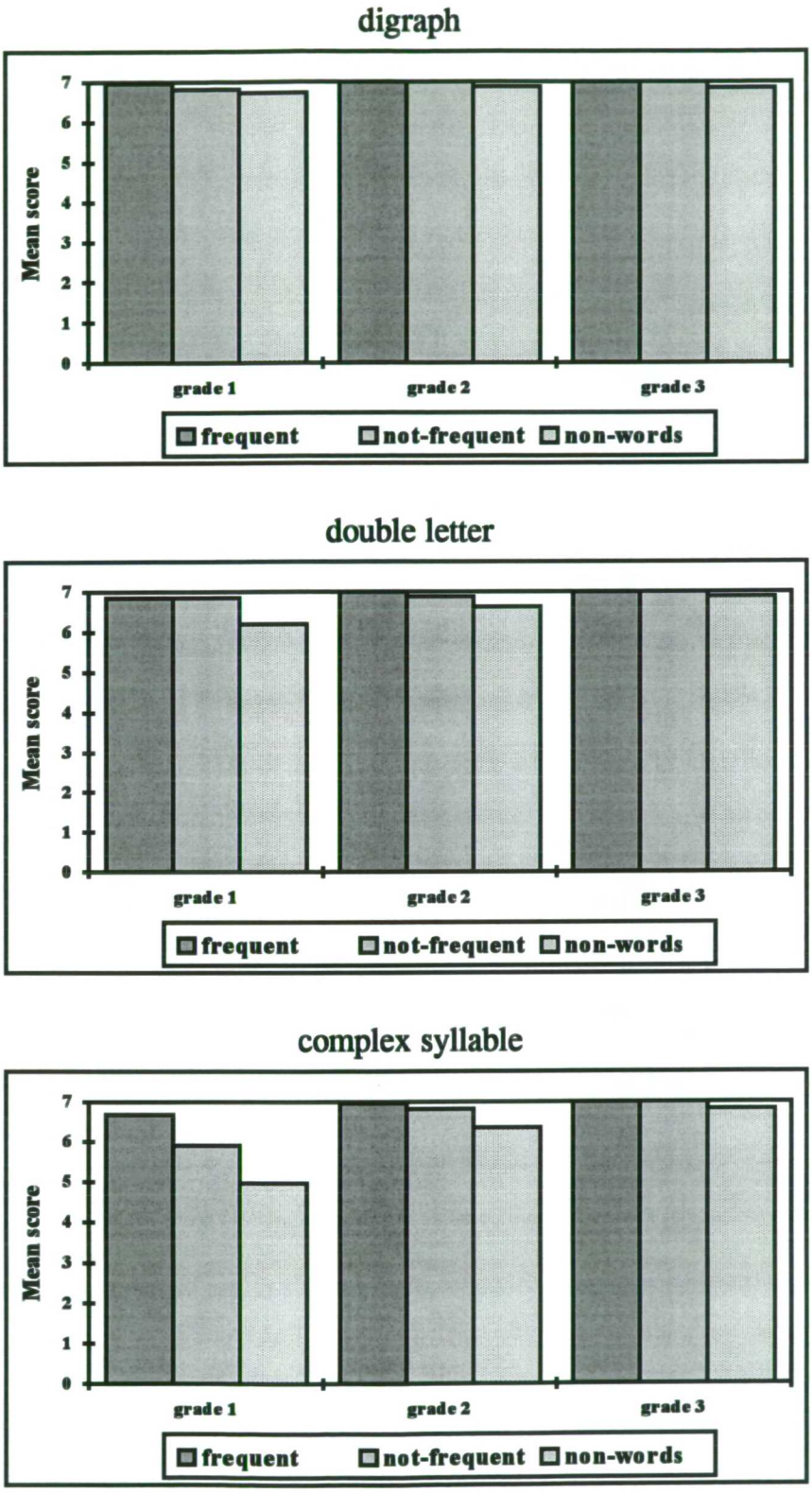


Figure 2.8
Mean score of words read correctly by age and frequency for the groups of two-to-one constant relations words

Maximum score = 7

double letters.

2.III.d. Do children master different conditional rules at the same time?

The main purpose of this analysis is to test whether conditional rules are mastered at the same time. In testing this hypothesis three different groups of words that have one-to-one variable relations between graphemes and phonemes were included in the analysis. The three conditional rules are: the αυ-ευ combination (the pronunciation of the second letter varies depending on the following letter), the vowel cluster tonos (a digraph is pronounced as two separate letters if the stress mark appears on the first letter of the digraph), and the vowel cluster dialitika (a digraph is pronounced as two separate letters if a diacritic mark called dialitika appears on the second letter of the digraph). Because frequency was found in the previous analyses to influence children's reading it was also included in this analysis.

Mean scores of correct responses were subjected to a 3 X 3 X 3 mixed model Analysis of Variance (age: 6 year-olds, 7 year-olds, and 8 year-olds; group of words: αυ-ευ combinations, vowel cluster tonos, and vowel cluster dialitika; and frequency: frequent words, not-frequent words, and non-words) with age as the between-subjects factor and group of words and frequency as the within-subjects factors. Means are presented in Table 2.5.

The main term of age was significant ($F(2,99)=47.89$, $p<.001$). A subsequent post hoc (Newman Keuls) test showed that all the comparisons were significant ($p<.001$) (see Figure 2.9). The analysis produced a significant effect for the group of words factor ($F(2,198)=49.88$, $p<.001$). Post hoc (Newman Keuls) test revealed that all the contrasts were significant ($p<.001$) (see Figure 2.10). The two way interaction, age by group of words, was significant ($F(4,198)=7.82$, $p<.001$). The frequency

Table 2.5

Means and standard deviations for the subgroups of the one-to-one variable relations class of words

		Words		Non-Words
		Frequent	Not-Frequent	
One-to-one Variable Relations	αυ-ευ Combination	6.96 (.20)	6.30 (1.27)	3.90 (1.81)
	Vowel Cluster Tonos	5.50 (2.23)	3.80 (2.17)	3.60 (2.07)
	Vowel Cluster Dialitika	6.10 (2.00)	4.50 (1.95)	4.20 (2.24)

* Standard Deviation in brackets

Maximum score=7 for each variable

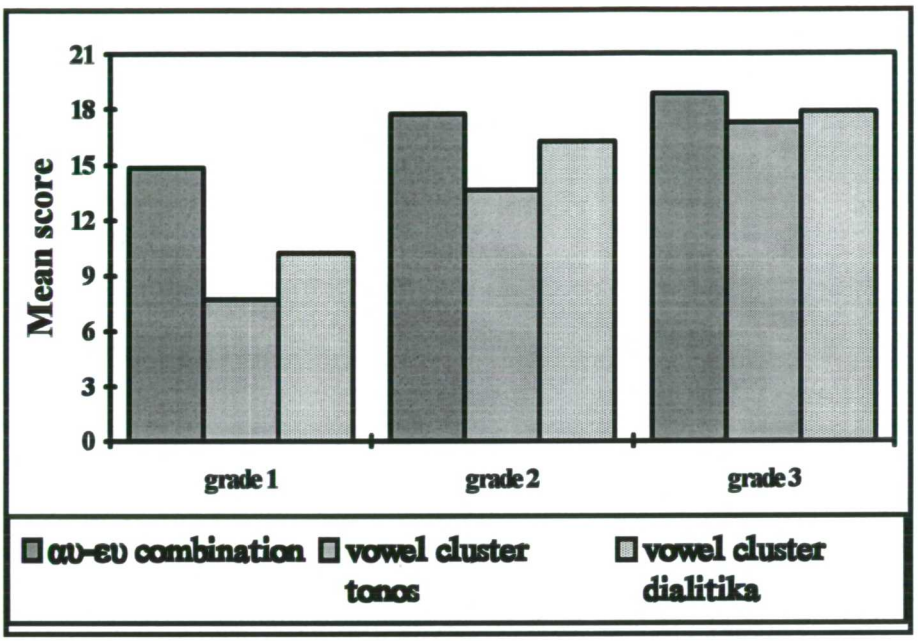
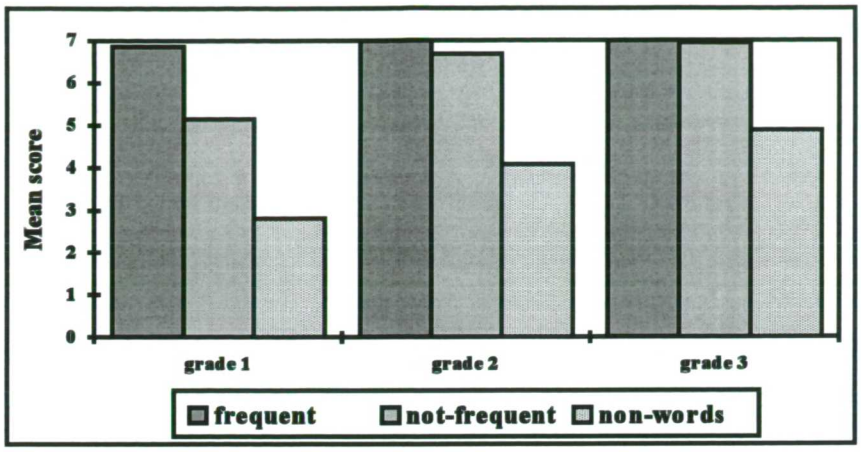


Figure 2.9

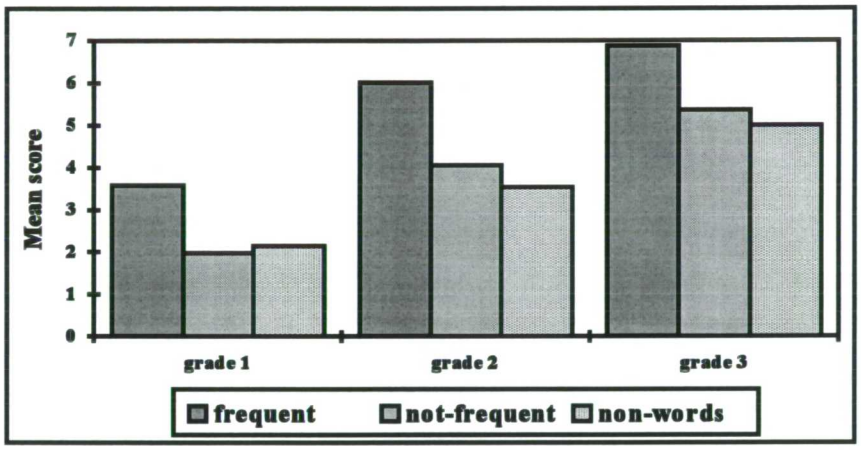
Mean scores of words read correctly by age and group of words for the one-to-one variable relations class of words

Maximum score = 21

αυ-ευ combination



vowel cluster tonos



vowel cluster dialitika

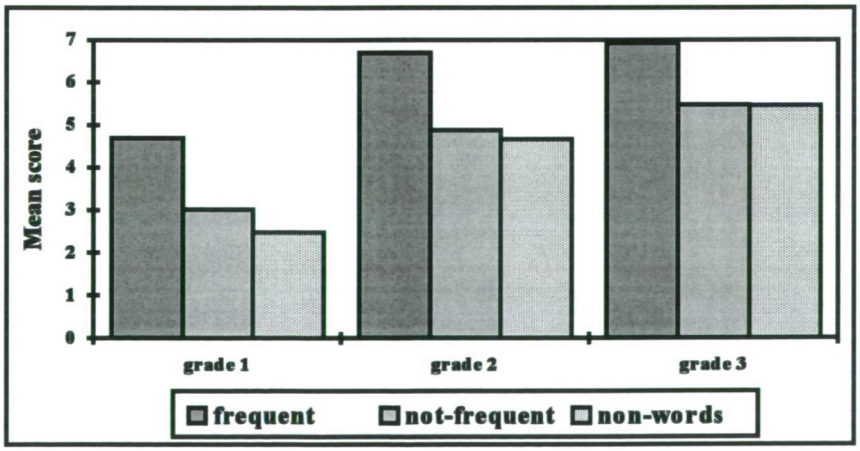


Figure 2.10

Mean score of words read correctly by age and frequency for the groups of one-to-one variable relations words

Maximum score = 7

factor was also significant ($F(2,198)=322.96$, $p<.001$). As a Newman Keuls test revealed all the comparisons were significant ($p<.001$). The two way interactions, age by frequency and group of words by frequency, were significant ($F(4,198)=4.01$, $p<.005$ & $F(4,396)=40.77$, $p<.001$ respectively). The three way interaction, age by group of words by frequency, was also significant ($F(8,396)=5.05$, $p<.001$).

Considering the low scores obtained by all children and especially by the first graders in the not-frequent and non-words, a further analysis examined whether they performed above chance level (that is, significantly better than one in two correct, because in all three conditional rules there were two possible pronunciations). The maximum score for each category of the three conditional rules (frequent, not-frequent, non-words) is 7. A binomial test showed that the third graders performed above chance level in all categories of words and non-words ($p<.001$). Grade two children performed above chance level in all categories of words and non-words ($p<.001$) but not in αυ-ευ combination non-words, vowel cluster tonos not-frequent words and vowel cluster tonos non-words ($p=.229$; $p=.229$; and $p=.727$ respectively). First grade children performed above chance level only in four categories of words: αυ-ευ combination frequent and not-frequent words, vowel cluster dialitika frequent and not-frequent words ($p<.001$).

In summary, the hypothesis that some conditional rules are learned easier and faster than others was confirmed by the results of this analysis. The results showed that vowel cluster tonos category was the most difficult one amongst the one-to-one variable relations class of words. Different hypotheses for the development of children's knowledge of conditional rules will be explored in the discussion section. The above results also replicated the earlier observation that f requency has an effect on children's reading but only when difficult words are involved. This is clearly shown in Figure 2.10.

2.IV. Discussion and Conclusions

2.IV.a. Summary of the results

1. There were significant age differences between the three groups of children. In general, younger children performed worse than older children showing a developmental progression.

2. There were significant differences between children's reading of words of different classes which varied across different age groups. In general, words and non-words with one-to-one constant relations between graphemes and phonemes were easier than words and non-words with two-to-one constant relations between graphemes and phonemes; both were easier than words and non-words with one-to-one variable relations between graphemes and phonemes. The differences were more marked for the younger children.

3. There were significant differences between children's reading of words of different frequency which varied across age and word class. The effect of frequency was more pronounced on the reading of younger children and the reading of more difficult words.

4. There were significant differences between children's reading of words and non-words which varied across age and word class. Words (both frequent and not-frequent) were easier than non-words for the younger children and for the more difficult words.

5. There were significant differences between children's reading of words that involve different syllable types (simple and complex) which varied across age. Words with complex syllables were more difficult than words with simple syllables

for the younger children.

6. There were no significant differences between children's reading of words of different length.

7. There were significant differences between children's reading of words that involved different conditional rules.

In the next section, these results are discussed in more detail in relation to each of the hypotheses of the study.

2.IV.b. Discussion of results

Hypothesis 1: The development of reading in Greek, as in English, first goes through an alphabetic stage where segmentation strategies are used before the use of more complex strategies for representing phonemes.

This hypothesis was supported by the data. Looking first at the children's overall performance, the significant differences between the three age groups showed that reading Greek is a developmental process. Greek is different from English at least in two ways: a) it presents constant relations between graphemes and phonemes and it does not have irregular words; and b) it has a more clear syllabic structure. Despite these differences between the two languages a stage model from simple to complex still holds for Greek. This was shown by the significant differences between children's performance in the different classes of words. Words that involve constant relations between graphemes and phonemes can be read earlier than words that involve more complex relations between graphemes and phonemes. This result is consistent with Marsh et al.'s (1981) and Frith's (1985) theories of reading development which have shown that English-speaking children follow a similar

developmental path. However, Greek children seem to progress faster than their English counterparts. By the age of eight Greek children can read the majority of words, including those that involve conditional rules, while, according to Marsh, it is only after the age of ten that English children master these rules. This result is consistent with Wimmer and Goswami's (1994) findings, that German speaking children progress faster in reading than English speaking children.

Turning now to the strategies that children use, the results showed that Greek children in the first stage of their reading development use a sequential strategy and later develop more complex strategies. To make this point the results for each of the age groups will be discussed separately. Firstly, the younger children (6 years old) performed differently in the different classes of words. Words with constant relations between graphemes and phonemes were easier than words with variable relations between graphemes and phonemes. The former can be easily read using a simple sequential strategy whereas the latter need a more complex phonological strategy. The small, though significant difference between first graders' performance in the one-to-one constant relations and two-to-one constant relations classes of words show that even these children do not use a simple, one letter for one sound, sequential strategy. They know that two letters may represent one sound and their performance was very high in the two-to-one constant relations class of words (mean 58 out of 64). Significant differences between frequent words, not-frequent words and non-words, however, show that first grade children have not yet acquired this strategy completely. These children seem to be in a transitional stage where they are beginning to understand that there are more complex phonological rules such as digraphs and double letters which cannot be read using a one letter for one sound sequential strategy. These children have great difficulty in reading words and non-words that involve conditional rules. Overall, their performance was below chance level in the one-to-one variable relations words. The finding that they performed above chance level in some groups of frequent and non-frequent words of this class,

however, is indicative for the use of other than a complex phonological strategy for the reading of these words. This hypothesis is examined in the next two studies. The finding that Greek children use a sequential strategy in the first stages of their reading development is consistent with the results of Porpodas (Porpodas, 1993; Porpodas et al., 1990).

Second grade children, too, use phonological strategies in their reading although they are more complex than those used by first graders. Their performance is significantly better than that of first graders and they performed at almost ceiling level in both the one-to-one constant relations and the two-to-one constant relations class of words. These children have acquired a phonological strategy that allows them to read words that involve digraphs and double letters. The difference between frequent words, not-frequent words and non-words is rather small (although some were significant) for the classes of words that involve constant relations between graphemes and phonemes. Their performance, however, shows that they have not yet acquired a more complex strategy for the reading of words that involve one-to-one variable relations between graphemes and phonemes. Their performance on some groups of not-frequent words and non-words was at chance level. The finding that these children performed above chance level in the vast majority of words (frequent or not) shows that either they have started to acquire a more complex phonological strategy for the reading of these words or that they use other strategies, such as inferences from the pronunciation of known words or contextual cues. This hypothesis is examined in the next two studies.

Lastly, third grade children (8 years old) have already acquired both a simple sequential strategy for the reading of the one-to-one constant relations class of words and a more complex phonological strategy for the reading of two-to-one constant relations class of words. This is very clear from the result that there were no significant differences between frequent words, not-frequent words and non-words.

These children performed at above chance level in the one-to-one variable relations class of words indicating that they have started to use a more complex phonological strategy for the reading of these words. However, significant differences between frequent words, not-frequent words and non-words show that even third grade children have not yet completely acquired this strategy and that they might use other strategies to read these words.

In the present study, the findings of previous researchers are extended in two ways: one concerning reading development in general and the second concerning reading development in Greek. In previous studies, it was claimed that children at a certain stage of their reading development use a decoding strategy which allows them to read words that do not involve conditional rules (Marsh et al. 1981). In Frith's (1985) theory, during the alphabetic stage children acquire both simple and complex phonological rules with simple first and complex later. The present study shows that phonological strategies are developed over a period of time with a simple one letter for one sound sequential strategy first, a more advanced sequential strategy which allows for the reading of digraphs and double letters later and an even more complex phonological strategy which accounts for the reading of words that involve conditional rules at the end. This view is consistent with Goswami and Bryant's (1990) argument that children's phonological awareness develops over time and as children are taught to read and write.

The present study extends our knowledge of reading development in Greek by examining the phonological structure of the words in greater detail than in previous studies (Porpodas, 1993; 1990; Porpodas et al., 1990). In these studies words were characterised as regular or irregular, requiring either the use of a phonological strategy or the use of a visual strategy in reading. The present study has shown that phonological strategies of different complexity can account for the reading of all Greek words because in Greek there are different classes of regular words but there

are no irregular words.

Hypothesis 2: Greek children use phonological units bigger than phonemes in the first stages of their reading development.

This hypothesis was supported by the data although not with respect to all age groups. Children from the two younger groups performed significantly worse in the groups of words with complex syllables than in the words with simple syllables. This result is consistent with Bryant et al.'s (1989, 1990) findings that English children in the first stages of reading development rely on onset and rime which are phonological units bigger than phonemes. This result is also consistent with Aidinis and Nunes' (1997) finding that both phoneme and syllable awareness make independent contributions to Greek children's reading.

It has to be noted however, that as children get older the effect of the complexity of the syllable on reading lessens. By grade three the effect of the complexity of the syllable disappears and children seem to use phonological analysis at the level of phonemes at this age. This might be because children develop their phonological skills through their experience of reading and spelling. This view is consistent with Goswami and Bryant's (1990) argument that phonological awareness develops from bigger to smaller units through reading and spelling experience.

Hypothesis 3: All conditional rules are not mastered at the same time.

When the data were examined for each of the three conditional rules separately, quite a different pattern of results emerged. There were significant differences between children's performance in the three conditional rules for all the age groups with the two conditional rules that involve vowel clusters being more difficult than the αυ-ευ combination. It should be mentioned that the former conditional rules are

taught in the first grade while the latter is not, although children are taught that these combinations can be pronounced in two different ways.

A possible explanation for this finding is that children right from the beginning are taught that two vowels when they appear together in a word are pronounced as one letter. Later on, they learn that these two vowels can be pronounced separately although they appear together in the word either because the stress mark is on the first letter of the digraph or because a diacritic mark called dialitika is on the second letter of the digraph. The results for the two-to-one constant relations class of words showed that children, even the younger ones, have no difficulty in reading the words with digraphs. It takes, however, a considerable amount of time for children to understand the conditional rules involving these vowel clusters.

In the αυ-ευ combination conditional rule, children of all the age groups seem to know the two possible pronunciations /af-εf or av-εv/[1]. In order to read these words children must know either the conditional rule or they must memorise the words' pronunciations. Frequency has no effect on grade three children's performance which was at ceiling level for both frequent and not-frequent words. There was, however, a significant difference between words and non-words. If grade three children knew the rule then such a difference should not exist. Children's performance in the non-words was above chance level indicating that these children did not choose one of the two possible pronunciations by chance but they consciously read the words using one of the pronunciations. These children either know the conditional rule but have not yet learned it completely or they have developed other strategies to cope with the reading of these words. Grade two children performed above chance level for frequent and not-frequent words for this conditional rule but they performed at chance level on non-words. This result indicates that these children do not know this rule or that they have a preliminary

[1] No child pronounced these combinations as two separate letters i.e. as /ai/.

knowledge of it and they use other strategies to compensate for their incomplete knowledge. Grade one children are at a similar but even less advanced level than grade two children.

In the vowel cluster dialitika conditional rule there are, also, two possible pronunciations: either as a digraph representing one phoneme or as two separate letters representing two phonemes. In contrast to the αυ-ευ combination conditional rule, if children are confused on the vowel cluster dialitika conditional rule, they must know both that two letters represent a digraph and the conditional rule. A child would not be confused if s/he knows that two letters are pronounced as one phoneme but s/he does not know that these two letters are pronounced separately under certain conditions. Children seem to learn digraphs quite fast and easily but then only from grade two onwards do they start to incorporate this conditional rule. We cannot rule out, however, the possibility that they use other than a simple phonological strategy in reading these words, such as contextual cues or inferences from the pronounciation of known words.

Similar difficulties seem to apply for the vowel cluster tonos conditional rule, which seems to be the most difficult one. In addition to the difficulties that apply for the vowel cluster dialitika conditional rule, in this rule children must understand that the stress mark, apart from marking the most stressed syllable in the word, plays a different role making two letters that are usually pronounced as one, pronounced separately. It is clear that children only understand this dimension of the stress mark from grade three onwards. Younger children performed at chance level when they were asked to read not-frequent words and non-words involving this rule.

2.IV.c. Conclusions and limitations

Study 1 has shown that Greek children develop their reading ability using simple

phonological strategies first before they use more complex strategies. There was evidence that children from different age groups used different strategies in their reading. Six year old children use a simple, one letter for one sound, sequential strategy although there is evidence that a more complex strategy for the reading of words that involve digraphs and double letters has also been acquired by these children, although not completely. Seven year old children are more advanced than the six year old but they have not yet completely acquired a strategy that would help them to read words involving conditional rules. Lastly, the eight year old children seem to be at a more advanced stage in reading than the two previous groups because they read a substantial number of words involving conditional rules correctly. However, their development is not yet completed, since they cannot read correctly not-frequent words and non-words. In conclusion, reading development in Greek seems to follow a developmental sequence similar to the English language despite the fact that the former is phonologically more regular (shallow) than the latter.

Another interesting finding was that Greek children rely on phonological units bigger than phonemes, namely syllables, at the beginning of their reading development. Later, in the third grade, as their phonological ability improves, they concentrate more on the representation of phonemes.

Lastly, we have preliminary evidence that there is no specific age when children master conditional rules. Some conditional rules may be masterd faster and more easily than others. However, more research is needed to explore this claim in more detail.

Although this study has offered a description of Greek children's reading development it was limited in looking only at children's reading. Other measures such as phonological awareness both at the level of syllables and phonemes,

vocabulary knowledge and verbal intelligence in accordance with longitudinal designs would offer a more detailed description of this development, together with causal links between reading development and other factors. Such measures would help us see the effect of different levels of phonological awareness on reading words of different difficulty, and to understand better the development of children's phonological ability and the causes of this development.

Another limitation of the present study is that it does not allow for any interpretation for the strategies that children use for the reading of words that involve conditional rules. It is clear that children, especially the younger ones, have difficulty with these words. How do they read them? Even for the older children it is not clear whether they are able to read these words because they have learned the conditional rules. It might be that they use other strategies to read these words, such as inferences from the pronunciation of known words or other contextual cues. It might be that children have memorised their pronunciation. It would also be useful, in order to understand children's reading development, to see how skilled readers read these words. Thus tasks need to be developed which examine in greater detail children's and adults' reading of the words that involve conditional rules and the strategies that are used. This was the aim of the next two studies.

CHAPTER 3: STUDY 2
HOW DO GREEK CHILDREN READ WORDS THAT INVOLVE CONDITIONAL RULES?

3.I. Introduction

The purpose of this experiment is to examine the processes that children and adults use in reading words that involve conditional rules and to replicate the results of the previous study that different conditional rules are mastered at different times. In the previous study it was found that Greek children use a simple sequential strategy when they start to read and then they develop more complex strategies for the representation of phonemes. It was also found, that the words that involve conditional rules pose great difficulty for children in reading. Despite the substantial amount of words and non-words of this class that was read by children, especially the older ones, there were significant differences both between different word classes and between frequent words, not-frequent words and non-words indicating that children have not completely acquired a complex strategy for the reading of words that involve conditional rules, even at the age of eight. It was also found that some conditional rules are mastered earlier than others and more easily. The question that arose from these results was how children read the words that involve conditional rules.

According to Marsh's theory of reading development (Marsh et al., 1981), children can use conditional rules when they are reading, only at the final stage of reading development, c.e. well after the age of ten. Goswami and Bryant (1990) appeared to agree with Marsh's view. More specifically, they state that "we think that Marsh's claim, that children do not learn complex, conditional orthographic rules till quite late on, is plausible", and they continue that "there is very little evidence on this kind of learning" (p. 149). In Frith's theory (1985) phonological rules are learned

during the second phase of reading development although there is a developmental sequence with simple phonological rules first and more complex later.

It is thus reasonable to try to see how Greek children read words, the reading of which depends on conditional rules. More specifically the study will examine three conditional rules: i) the αυ-ευ combinations, where the second letter of the combination is pronounced differently depending on the following letter; ii) the vowel cluster tonos, where a digraph is considered as two separate letters because the stress mark appears on the first letter of the digraph; and iii) the vowel cluster dialitika, where a digraph is considered as two separate letters because a diacritic mark, called dialitika, appears on the second letter of the digraph. These rules were explained in greater detail in a previous chapter.

It has to be mentioned that the rule for the αυ-ευ combinations is not explicitly taught till the fifth or sixth grade. Children, from the first grade, are taught that the two letters, when they appear together they are pronounced either as /af-ef/ or as /av-ev/; they also read a lot of words which contain those two combinations without any explanation for the importance of the following letter. However, the other two rules are explicitly taught in the first grade and they appear to be less complex and easier to generalise. It is easier, for example, to learn that when in a digraph the stress is on the first letter (e.g. άι), or there are two dots on the second letter (e.g. αϊ), then the two letters must be read separately than that a letter of a combination pronounced as /f/ if it is followed by a voiceless consonant or as /v/ if it is followed by a voiced consonant or a vowel. Indisputably, the above claim assumes that children already know how to read digraphs. Evidence from the previous study showed that children, even first graders have no problem in reading words with digraphs. It was also found that the vowel cluster tonos conditional rule was more difficult than the other two and vowel cluster dialitika was more difficult than the αυ-ευ combinations. The aim of the present study was twofold: first, to replicate the results of the previous study;

and second, to examine the psychological processes underlie the learning of the conditional rules.

A possible strategy that children use in reading words which involve conditional rules is by making inferences or by analogy to the pronunciation of known words. Although Marsh and Desberg (1983) claimed that young children do not use the strategy of analogy spontaneously till the last stage of reading development, Goswami (1986, 1988a, 1988b, 1990a, 1990b) showed that children, as young as five, can make analogies in order to read unfamiliar words. There is a caution with the use of the word analogy here. Goswami's work is in fact about fixed pronunciations of particular letter sequences. Marsh et al. (1981) viewed this as a hierarchical rule rather than as analogy because it concentrates on phonological units such as onset and rime that have fixed pronunciations. According to Marsh et al.'s (1980) definition, children that use analogy "instead of decoding words they search for an analogue word and pronounce the unfamiliar word by analogy to the known word" (p. 343-344).

In contrast to Marsh's view, is the claim that children must possess some decoding ability in order to be able to read words that share an orthographic pattern with a known word (Ehri and Robbins, 1992; Bruck and Treiman, 1992; Goswami and Bryant, 1990). According to this claim, children must be able to segment a word at least into bigger than phonemes phonological units and then to use these phonological units to make inferences from the pronunciation of a known word. By using such a strategy children also develop their phonological skills by understanding further the relations between graphemes and phonemes (Goswami and Bryant, 1990). For example, in English it has been found that onset-rime awareness help children to read unknown words that share either the onset or the rime with a known word. There is evidence, however, that children do not use this strategy spontaneously (Muter et al., 1994; Marsh et al., 1981). In all these studies, children

either had a clue word in front of them or they had been told that the target words have been produced by changing one letter from a real word.

The results from study 1 showed that Greek children are using phonological strategies in their reading. By using these strategies Greek children can read words that have constant relations between graphemes and phonemes. However, they need more complex strategies for the reading of words that involve higher order orthographic rules, such as conditional rules, and even by the age of eight they have not yet acquired these complex strategies. What processes do Greek children use to learn these rules? How do adults read words that involve conditional rules? Do, both children and adults, use the strategy of making inferences from the pronunciation of known words in order to read unknown words? Do they use this strategy spontaneously and at what age?

According to Marsh et al. (1981) analogy is an optional strategy even for adults and its use depends on task factors although this strategy is available by stage four of reading development. Evidence that both children and adults make inferences from the pronunciation of known words in order to read unknown words that involve conditional rules have also obtained in Spanish (Sebastian and Vacciano, 1995). In this study the words and the non-words that were used involved the pronunciation of the letters C and G, which depends on the following letter. The non-words that they used were generated from real words, that were not used in the study, by changing one or two letters. The non-words were divided into two groups, changed and unchanged. In the former, the change of the letters of the real word did not influence the pronunciation of the target letter while in the former the change of the letters of the real word signified a change in the pronunciation of the target letter. They found that there were more mispronunciations for the changed non-words than the unchanged ones indicating that both children and adults use the strategy of analogy in their reading.

There are three reasons for caution for the interpretation of these results. Firstly, the participants of the study had not been asked to read the words from which the non-words were generated. Consequently, it cannot be concluded that the participants read the non-words by analogy to real words since there is no indication that they could read the real words. Secondly, they did not ask the children and the adults to justify their reading of the non-words. Thus the possibility that they read the non-words because they knew the conditional rule cannot be rejected although the difference between changed and unchanged non-words indicates that they did not know the rule. Lastly, there was no group of non-words that were not analogous to any real word to see how children and adults would read these non-words. Such a group of non-words could reveal useful information for the strategies that children use in reading words that involve conditional rules since an analogy strategy at the level of whole word could not be used for these words.

The hypotheses to be tested in this study are: I) although conditional rules require children to use a more complex strategy than a simple sequential strategy when they are reading, it depends on the nature of the conditional rule - how easy or difficult it is - and the age in which they will acquire it; and ii) children, at least in the second and third grades (seven and eight years old), and adults are able to use the strategy of making inferences from the pronunciation of known words in order to read unfamiliar words. It was expected that the results of the previous study that some conditional rules are mastered earlier and easier than some others would be replicated. It was also expected that second and third graders would read by analogy the αυ-ευ combination rule but not the other two rules which was expected to be already known. For the adults it was expected that they would know all the three conditional rules.

3.II. Method

3.II.a. Participants

The participants were 138 children and adults, equally divided between four age groups: 6 years - grade 1 - (mean age: 6 years and 5 months; range: 6 years one month - 6 years 11 months); 7 years - grade 2 - (mean age: 7 years and 5 months; range: 7 years 1 month - 7 years 11 months); 8 years - grade 3 - (mean age: 8 years and 8 months; range: 8 years 1 month - 9 years); adults (mean age: 29 years and 4 months; range: 23 years - 45 years 5 months); All the children were attending four different public schools in the city of Katerini, in North Greece. The children were selected randomly from the register list. The teacher of each class was asked to exclude from the list the children who had a serious problem with reading. Six children (all of them in the first grade) were excluded from the study because they could not even recognise all the letters of the alphabet. The children who participated in this study were different from those that participated in experiment 1 although from the same schools and classrooms. All the adults who participated in the study hold a university degree; the vast majority of them were teachers.

3.II.b. Design

In order to test the above hypotheses, words that involve all the three conditional rules were included in the study. All the words were taken from children's reading books and were controlled for frequency (all of them were of low frequency). A total of 45 words were selected, equally divided between the three conditional rules. Differences in children's performance on these words will allow us to see if children master the three conditional rules at different times. A second role of the real words was to assure us that children know how to read the words from which it was expected to make inferences. Another 10 real words for each of the three conditional

rules were selected and were used as control words. For the αυ-ευ combinations, where the second letter represents either the sound /f/ or the sound /v/ which can also be represented by single letters, ten control words that have the letters "φ" and "β" that represent the sounds /f/ and /v/ were included in order to be sure that children know these letters. For the two conditional rules that involve vowel clusters which otherwise represent digraphs, words that contain digraphs were used as control words, in order to be sure that children can read digraphs. In conclusion, three lists of 25 real words were produced, one for each conditional rule, with 15 experimental words (that involved the rule) and 10 control words (that did not involve the rule) randomly mixed.

From these lists of real words the analogous and not-analogous non-words were generated. The analogous non-words were produced by changing one letter from the real words. The not-analogous non-words were created to look like real Greek words, i.e. to have the endings, the syllables and the clusters of letters that could be found in Greek. There were no real words that matched the pronunciation and the appearance of the not analogous non-words. Analogous and not-analogous non-words were produced for both the experimental and control words. At the end, for each conditional rule there were three lists: real words, analogous non-words and not-analogous non-words.

The list with the real words was read always at the end in order to be sure that children were not prompted to use analogy. The order of presentation for the three conditional rules and for the analogous and not-analogous non-words was systematically varied. If there is no difference between children's performance in analogous non-words and not-analogous non-words - given that they know how to read the real words - then Greek children do not make inferences from the pronunciation of known words to read unknown words.

After the reading of the three lists of words and non-words of each of the conditional rules, the experimenter asked the participants to justify their reading of some words and non-words of the lists. This question was intended to give a clearer indication of whether the participant knew the conditional rule or they made inferences or analogies in reading the non-words.

Lastly, a group of adults who read the same words and non-words was included in order to see the difference in strategies, if there are any, that children and adults use in reading words that involve conditional rules. Moreover, adults' performance in this task will allow us to define our expectations for children. If adults do not know the conditional rule it cannot be expected that children know it.

Each participant, was seen in three sessions and had to read a total of 225 words and non-words, 75 per session. Words, analogous non-words and not-analogous non-words for the same conditional rule were given in each session. Adults were seen only in one session. Table 3.1 summarises the design. In total there were 18 variables (total scores) the maximum score of which was 15 (for the experimental words) and 10 (for the control words), and the minimum was zero. Having all these variables, comparisons between children's and adults' performance in the three conditional rules, as well as comparisons between analogous non-words, not-analogous non-words, and words can be made.

3.II.c. Materials and Procedure

All participants were individually interviewed in a separate room within their school (for the children) or in their home (for the adults). The participants were asked to read 9 lists of words and non-words each one consisted of 25 words or non-words, as described above. Before beginning the reading of the words and non-words the participants (only the children) were told that some of the words are easy to read but

Table 3.1

Design of Experiment 2

Conditional rule			αυ-ευ combinations	vowel cluster tonos	vowel cluster dialitika
Words		Experimental	15*	15	15
		Control	10	10	10
Non-Words	Analogous	Experimental	15	15	15
		Control	10	10	10
	Not-Analogous	Experimental	15	15	15
		Control	10	10	10

*Number of words and non-words used for each list

some of them are really very hard, even for older people. All participants were also told that some of the words are not real ones and that is why they do not make sense. There was no stopping rule and all participants read all the 225 words and non-words.

At the end of each session (e.g. after the three lists of the αυ-ευ combinations) the experimenter picked up some non-words from the lists and asked the participants why they decided to read them in that way (e.g. why they read the non-word "καυτάλι" as /kaftali/ and not as /kavtali/). The participants' answers were written on a separate sheet of paper.

Words were written in lower case, font size 16 and were presented on A4 paper, fifteen per page (the list of words that children read is presented in Appendix 2). The procedure lasted from 20 to 30 minutes for each participant for the three sessions and all the interviews were tape recorded. During the interview the experimenter had a different sheet, similar to the one the child had, and marked the mistakes the participant made, out of the participant's view.

3.III. Results

The results are described in four sections. In the first section the coding procedure and the participants' overall performance on the tasks are described. The second section focuses on the question of whether different conditional rules are mastered at the same time by comparing participants' performance in the three conditional rules. In the third section the hypothesis that readers, both beginning and skilled, make inferences from the pronunciation of known words in order to read unknown words that involve conditional rules is examined by comparing participants' performance in the real words, the analogous non-words and the not-analogous non-words.

Participants' performance in the control words and non-words is also examined in this section. Lastly, in the fourth sections the participants' justifications are considered in order to get a clearer view of the strategies that they use in reading of words that involve conditional rules.

3.III.a. Descriptive statistics

The reading of each word was coded as correct (1) and as wrong (0). As in experiment 1, a value of 2 was given when the participant read the word wrongly but rapidly corrected him/herself. These late values were recoded as 0, 1, and .5. Three identical analyses were carried out in order to see whether or not there was a difference in the results. However, all the three analyses produced identical results. The results which are presented in this chapter are those with the half point.

Cronbach's Alpha for item analysis on additive scales reliability analysis was performed for all the items in the lists. The analysis revealed, that all the experimental items were high reliable (Alpha > .98). The vast majority of control items had no variance and they were excluded from the analysis.

Total scores for each group of words and non-words (not-analogous non-words, analogous non-words, and words) were computed. The maximum score possible was 15 for the experimental items and 10 for the control items. The differences between the mean scores were analysed using Anovas with repeated measures across categories of words and age/grade level as between participants factor. Mean scores, standard deviations and distributions were examined and are given in Table 3.2. Figure 3.1 presents the distribution of scores in the three conditional rules for the children because there was no variation in adults' scores in the two conditional rules for the vowel clusters and a very small variation in the αυ-ευ combinations. As we can see from Table 3.2 the mean scores for each of the three conditional rules show

Table 3.2

Mean Scores and Standard Deviations for all the Variables

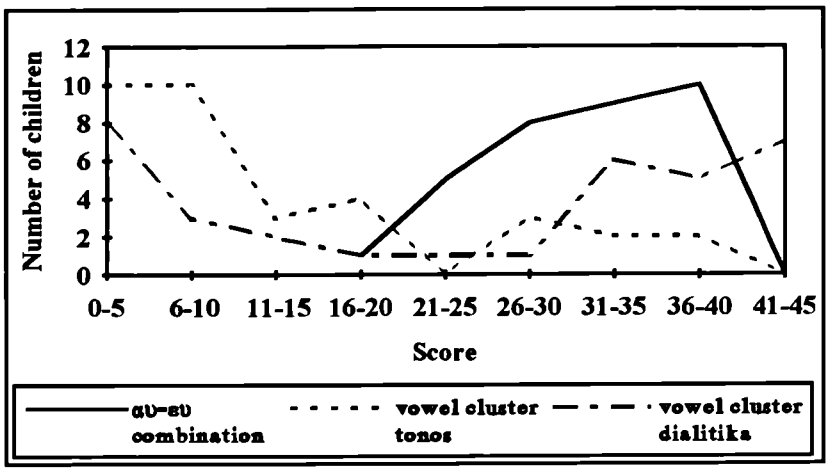
		Words	Non-Words	
			Analogous	Not-Analogous
	Experimental	14.37*	13.74	10.78
αυ-ευ		(1.31)***	(1.93)	(3.13)
Combinations	Control	10**	9.97	9.97
		(0)	(.27)	(.34)
	Experimental	11.78	10.19	9.25
Vowel Cluster		(4.30)	(5.34)	(5.32)
Tonos	Control	9.97	9.97	9.68
		(.24)	(.17)	(.61)
	Experimental	13.04	12.41	11.32
Vowel Cluster		(3.46)	(4.45)	(4.45)
Dialitika	Control	9.88	9.77	9.85
		(.35)	(.63)	(.36)

*Maximum score = 15

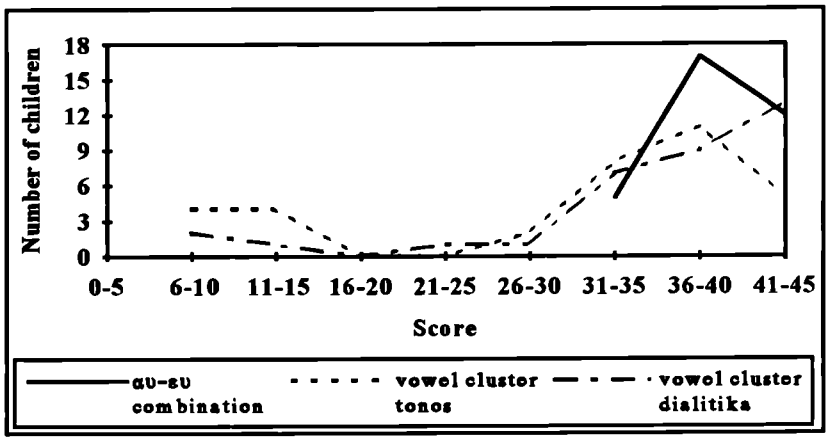
**Maximum score = 10

***Standard deviation in brackets

Grade 1 (6 years old)



Grade 2 (7 years old)



Grade 3 (8 years old)

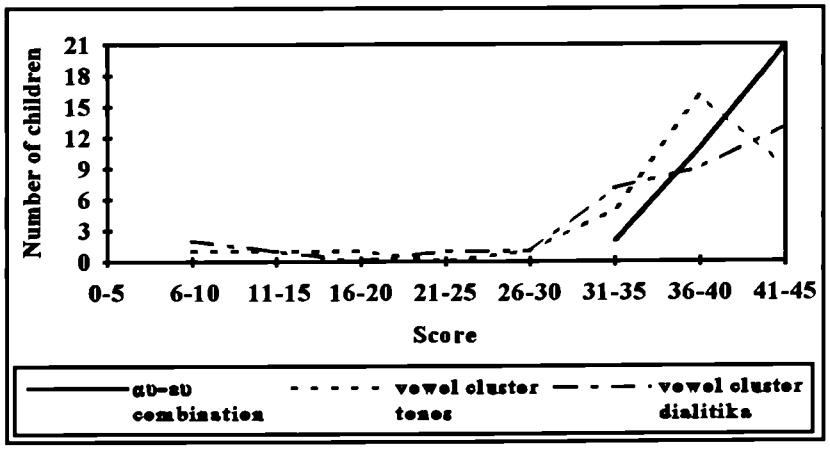


Figure 3.1
Frequency distribution of scores in each conditional rule
N=34 for each grade; Maximum score = 45

that there are differences between them. Differences between analogous and not-analogous non-words can also be seen while children's and adults' performance in the control words is almost at ceiling level.

3.III.b. Are different conditional rules mastered at different times?

In experiment 1, it was found that some conditional rules are learned faster and more easily than others. More specifically, it was found that Vowel-Cluster-Tonos words were more difficult than Vowel-Cluster-Dialitika words, and both were more difficult than αυ-ευ combination words. The first analysis in this experiment attempted to replicate these findings. The hypothesis was that there is a difference in the level of difficulty between the three conditional rules. Our prediction was that the difficulty will follow the same course as in experiment 1. Only the scores in the experimental items were subjected to this analysis because the control words did not involve conditional rules.

The number of correct responses was subjected to an Analysis of Variance in which the main factors were age (4: 6 year-olds, 7 year-olds, 8 year-olds, and adults) and conditional rule (3: αυ-ευ combination words, Vowel-Cluster-Tonos words, Vowel-Cluster-Dialitika words) with repeated measures on the last factor. Mean scores for each age group are presented in Figure 3.2.

The main term of age was significant ($F(3,128)=91.02$, $p<.001$). A subsequent Newman Keuls test established that all the comparisons were significant ($p<.001$). The conditional rule term was also significant ($F(2,256)=48.12$, $p<.001$). A post hoc (Newman Keuls) test showed that Vowel-Cluster-Tonos words were significantly harder than the other two categories ($p<.001$), and Vowel-Cluster-Dialitika words

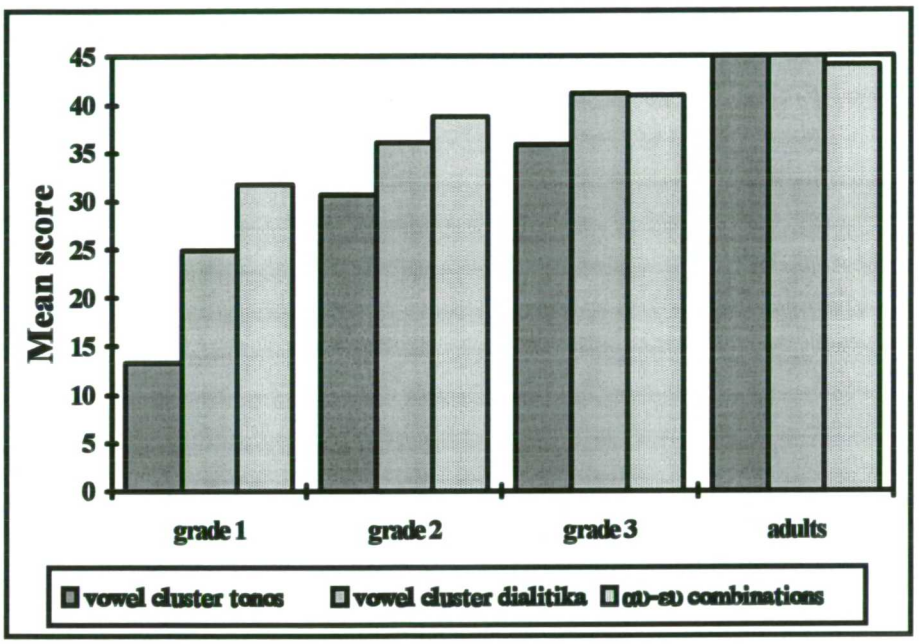


Figure 3.2
Mean number of words read correctly by conditional rule and age group
Maximum score = 45

were significantly harder than αυ-ευ combination words ($p<.001$)[1]. The two-way interaction age by conditional rule was significant ($F(6,256)=12.70$, $p<.001$). The means of the participants' correct responses were explored using the Newman Keuls post-hoc tests and this revealed that there was no significant difference between αυ-ευ combinations and vowel cluster dialitika conditional rules for the third graders ($p=818$). Also, there was no significant difference between vowel cluster dialitika and vowel cluster tonos conditional rules for the adults ($p=1$). For this age group the αυ-ευ combinations conditional rule was significantly harder than the two other conditional rules ($p<.01$). Thus, the difficulty of each of the conditional rules is different for different ages. This is clearly demonstrated in Figure 3.2.

The results of the present experiment replicated the findings of the previous study that different conditional rules pose different difficulty on children's reading. It was confirmed that vowel cluster tonos is the most difficult rule for children and the αυ-ευ combinations the easiest one. Possible explanations for these results have already been discussed in the previous study and will also be discussed in the discussion section of this chapter. It was also found that as children get older the differences between the three conditional rules decrease. In the third grade, for example, there is no significant difference between the αυ-ευ combinations and the vowel cluster dialitika conditional rules. As children getting older and they read more words they develop strategies that help them to read these words and to learn the conditional rules so as to use them effectively in their reading. It is clear from Figure 3.2 that adults have acquired all the three conditional rules although in the αυ-ευ combinations - which was the easiest rule for the children - they performed slightly worse than in the other two conditional rules.

[1] Identical results were obtained when the same analysis were carried out separately for not-analogous non-words, analogous non-words, and real words.

In brief, the results of experiment 2 were similar to those of experiment 1, as far as the differences between the three conditional rules are concerned. The strategies that children use in reading these words are examined in the next analyses.

3.III.c. Do Greek children and adults make inferences or analogies from known words in order to read unknown words that involve conditional rules?

It was hypothesised that Greek children make inferences from the pronunciation of known words in order to read words that involve conditional rules. It was also hypothesised that adults can use conditional rules in their reading because they have already learned them. It was predicted that children's performance in the analogous non-words would be better than in not-analogous non-words. It was also predicted that children would perform better or similarly to the analogous non-words in the real words because it is was expected that they would use these words as the basis for their inferences. Significant age differences were also predicted.

It was also hypothesised that participants' performance in the control words would reach ceiling levels showing that children know: firstly, to pronounce the phonemes /f/ and /v/; and secondly, to read words that contain digraphs. Although these control words and non-words were initially included in the study to provide evidence for this hypothesis, they were also used to test whether children and adults make inferences from the pronunciation of known words to read unknown words that do not involve conditional rules. Thus, it was further hypothesised, that for the control words, there would be no significant differences between analogous non-words and not-analogous non-words while differences between words and non-words were expected. All the control words had constant relations between graphemes and phonemes. In the previous study it was found that Greek children, right from the first grade, use a sequential strategy for the reading of words and non-words with constant relations between graphemes and phonemes quite effectively. It was

predicted, however, that there would be significant age differences.

In order to test the above hypotheses two identical analyses were carried out and are reported: the first one, for the words and non-words that involve conditional rules; and a second for the control words and non-words.

Analysis for the words and non-words that involve conditional rules (experimental words).

A 4 X 2 X 3 X 3 (age (4: 6 year-olds, 7 year-olds, 8 year-olds, and Adults), order of presentation (2: not-analogous - analogous, analogous - not-analogous), conditional rule (3: αυ-ευ combinations, vowel cluster tonos, and vowel cluster dialitika) and group of words (not-analogous non-words, analogous non-words, and words) Analysis of Variance was carried out, with repeated measures on the two last factors. Figure 3.3 shows the means for the words, analogous non-words, and not-analogous non-words for each age group. As can be seen from this Figure the older the participant the more words and non-words that involve conditional rules can be read. It can also be seen that all the participants performed better in the analogous non-words than in the not-analogous non-words. Figure 3.3 also shows that the more words that a participant read correctly the more analogous and not-analogous words read.

The main term of age was significant ($F(3, 128)=91.02$, $p<.001$). Post hoc (Newman Keuls) test showed that each older age group performed better than the younger ones ($p<.001$) (see Figure 3.3). The order of presentation term was not significant ($F(1,128).76$, $p=384$). The conditional rule term was significant ($F(2, 256)=48.12$, $p<.001$). This analysis has already been presented in the previous section. The group of words term was significant ($F(2,256)=454.47$, $p<.001$). A subsequent Newman Keuls test revealed that participants performed significantly worse in not-analogous non-words than in analogous non-words ($p<.001$), and in analogous non-words than

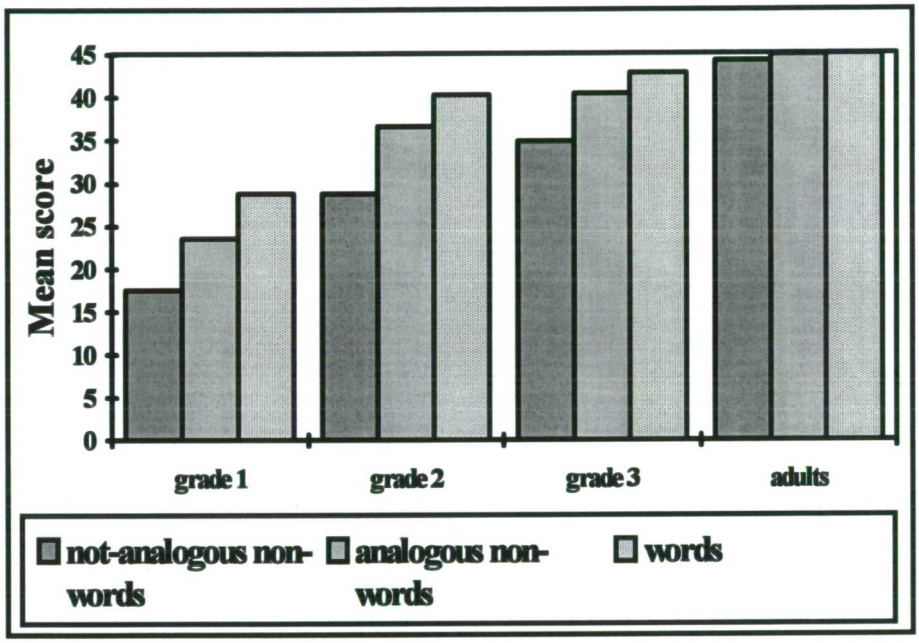


Figure 3.3
Mean number of correct responses by age and group of words for the experimental items

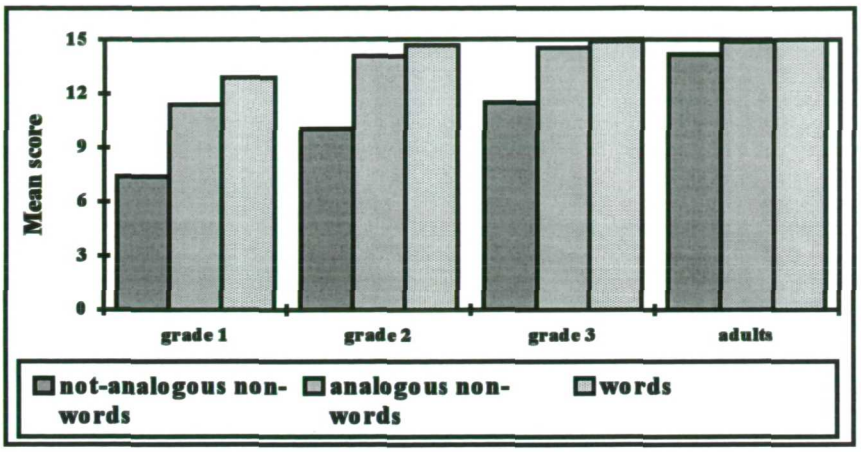
Maximum score = 45

words ($p<.001$). This is also demonstrated in Figure 3.4. The two way interaction age by conditional rule was significant ($F(6,256)=12.7$, $p<.001$). This interaction has already been analysed in the previous section.

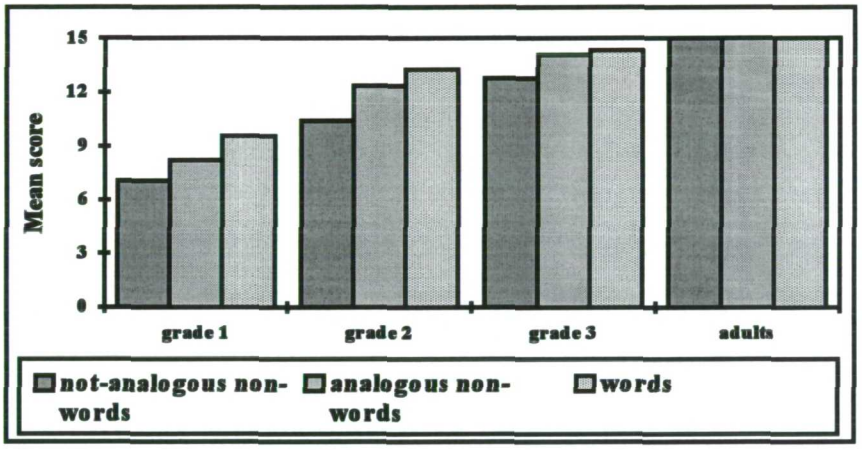
The two way interaction age by group of words was also significant ($F(6,256)=45.93$, $p<.001$). The interaction between conditional rule and group of words was significant ($F(4,512)=43.42$, $p<.001$). The three way interaction age by conditional rule by group of words was significant ($F(12,512)=3.54$, $p<.001$). Post hoc (Newman Keuls) tests showed that for the adults there were no significant differences between words, analogous non-words and not-analogous non-words for both the vowel cluster rules. No significant difference between words and analogous non-words for the adults was also found for the αυ-ευ combinations. No other interaction was significant.

In summary, the results showed that children use the strategy of making inferences from the pronunciation of known words in order to read unknown words that involve conditional rules. The results showed that when a non-word is analogous to a real word that the child knows, then it is easier for the child to read this non-word than it is when the non-word has no relation to a real word. By using this strategy children develop their phonological awareness and at the end they learn these complex orthographic rules. There are, however, some conditional rules that are not learned and even adults use the inference strategy to read the words that involve these conditional rules. This is clearly demonstrated from the difference between analogous and not-analogous non-words for the αυ-ευ combinations while no such difference was found for the other two conditional rules. Lastly, an interesting result is that although for children the easiest conditional rule is the αυ-ευ combinations for adults this is the most difficult, while in the two other conditional rules adults performed at ceiling level.

αυ-ευ combinations



vowel cluster dialitika



vowel cluster tonos

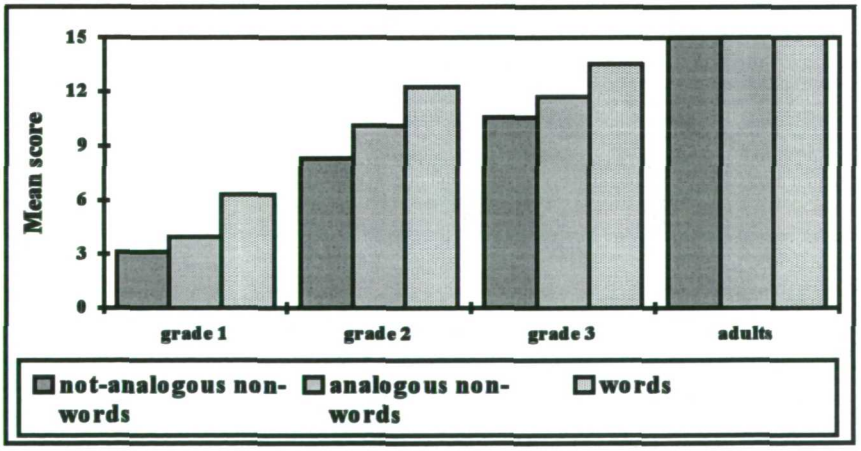


Figure 3.4

Mean number of correct responses by age and group of words for each conditional rule for the experimental items

Maximum score = 15

Analysis for the words and non-words that do not involve conditional rules (control words).

The analysis for the differences between words and non-words of the different conditional rules and between the analogous non-words, not analogous non-words and words that was carried out for the experimental items was performed for the control items. Because order of presentation was not found to be significant in the analysis of the experimental items it was excluded from the analysis for the control items.

A 4 X 3 X 3 (age (4: 6 year-olds, 7 year-olds, 8 year-olds, and Adults), conditional rule (3: control words for the αυ-ευ combinations, control words for the vowel cluster tonos, and control words for the vowel cluster dialitika) and group of words (not-analogous non-words, analogous non-words, and words) Analysis of Variance was carried out, with repeated measures on the two last factors. The differences between participants' performance in the control words for the three conditional rules are presented in Figure 3.5. As this Figure shows there were no large differences between children's and adults' performance in the control words of the three conditional rules. Figure 3.6 shows the means for the words, analogous non-words, and not-analogous non-words for each age group. As can be seen from this Figure there are very small differences between the three groups of words for all the participants.

The main term of age was significant ($F(3,132)=3.57$, $p<.05$). A subsequent Newman Keuls test indicated that first and second graders performed significantly worse than adults ($p<.05$), while there was no significant differences between the performances of first, second and third graders and between the performances of third graders and adults (see Figure 3.5).

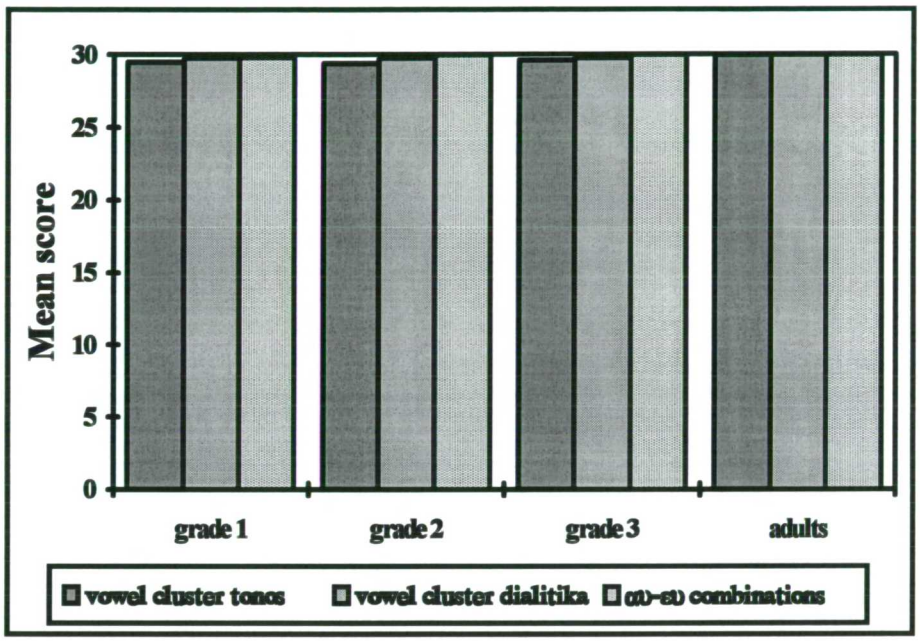


Figure 3.5
Mean number of correct responses by age and conditional rule for the control items
Maximum score = 30

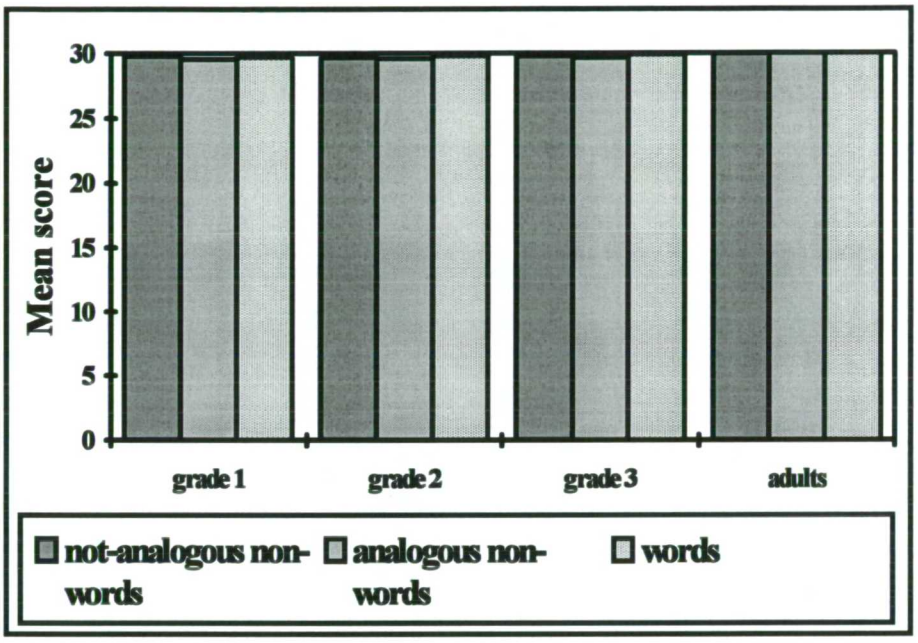


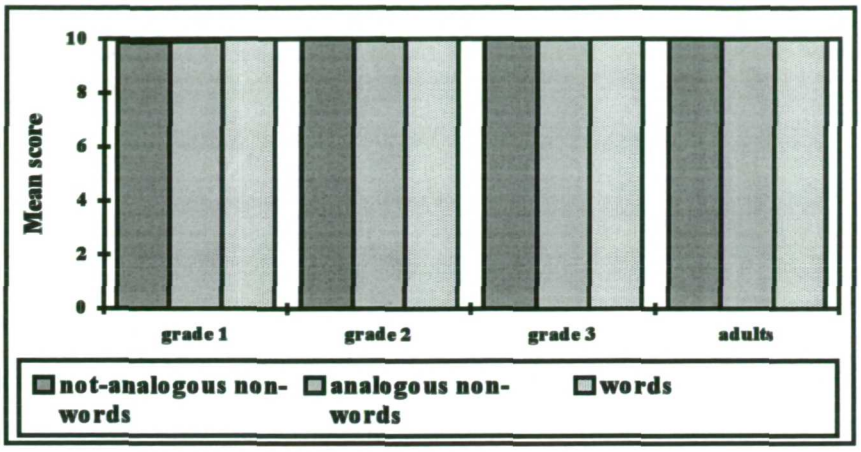
Figure 3.6
Mean number of correct responses by age and group of words for the control items
Maximum score = 30

The analysis revealed a significant effect for the conditional rule factor ($F(2,264)=19.38$, $p<.001$). A post hoc (Newman Keuls) test showed that this was because second graders performed significantly better on the αυ-ευ combination control words and non-words than in the control words and non-words for the two vowel cluster conditional rules ($p<.001$) and significantly better in the vowel cluster tonos than in the vowel cluster dialitika conditional words and non-words. There was no significant difference between the performance in the control words and non-words for the other three age groups. This can be seen in Figure 3.7. The two way interaction age by category of words was not significant ($F(6,264)=1.66$, $p=.132$).

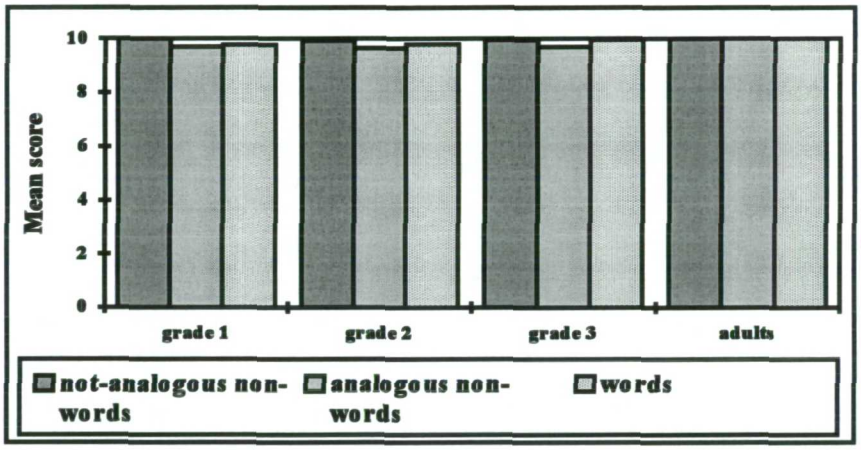
The group of words term was significant ($F(2,264)=3.60$, $p<.05$). A post hoc (Newman Keuls) test established that the second graders performed significantly better in the control words than in the control not analogous non-words in the two vowel cluster conditional rules ($p<.05$) while there were no significant differences between control words, control analogous non-words and control not-analogous non-words for the other age groups (see Figure 3.7). The interaction between age and group of words was not significant ($F(6,264)=.67$, $p=.672$).

The results for the control words and non-words showed that children when they have to read words that involve constant relations between graphemes and phonemes do not use the strategy of making inferences from the pronunciation of a known word in order to read an unknown word. This is demonstrated by the lack of significant differences between words, analogous non-words and not-analogous non-words. Even for the second graders for whom significant differences were found, these differences were very small. In addition there were no significant differences between the control items for the conditional rules. This demonstrates that Greek children use a sequential strategy in reading and words with constant relations between graphemes and phonemes are very easy for them. Again the significant

αυ-ευ combinations



vowel cluster dialitika



vowel cluster tonos

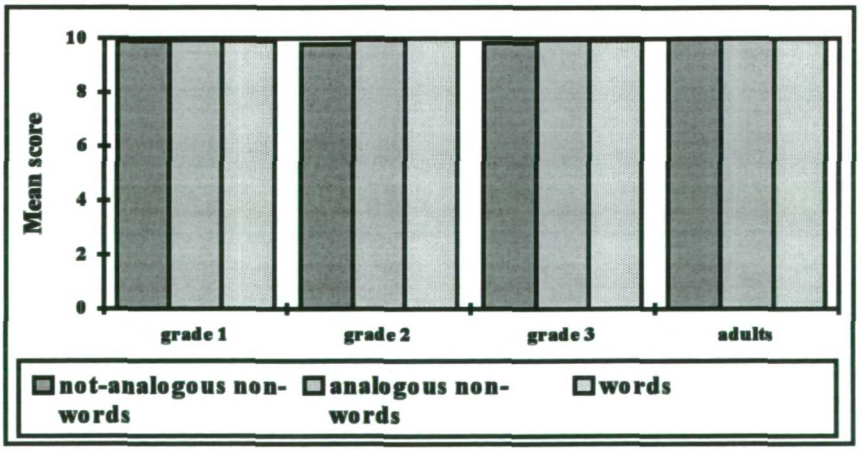


Figure 3.7
Mean number of correct responses by age, conditional rule and category of words for the control words and non-words

Maximum score = 10

differences between the control items of the three conditional rules that were found for the second graders were quite small and only for some of the groups of words (i.e. only for the analogous non-words and not-analogous non-words.

3.III.d. Analysis of the Justifications

As has been mentioned in a previous section, after each participant had completed the reading of the three lists of analogous non-words, not-analogous non-words and words for each conditional rule, the experimenter picked up some words that had been read either correctly or wrongly and asked the participant to justify the reading of these words. The participants had to justify only their reading of analogous and not-analogous non-words. Because the justifications that had been found in αυ-ευ combinations are different from those that had been found in the two conditional rules that involve vowel clusters they are presented in two different sections.

3.III.d.1. Justifications for αυ-ευ Combinations

Five types of justifications were used by participants in order to justify their reading of non-words that contain the αυ-ευ combinations:

1. Guessing or no explanation. This justification was given to participants who either said that they pronounced the target word by guessing the pronunciation or they did not give any explanation.

e.g. *Maria 6 years 5 months (1st grade)*: "I read it (the word "χαύρητο") as /chavrito/ and not as /chafrito/ because I know that sometimes the αυ is read as /af/ and some times as /av/. So I chose one of them. Is it the right one?"

Yiannis 8 years 7 months (3rd grade): "I don't know. Sometimes it is read as /af/ and sometimes as /av/. I always have trouble with this".

2. Guessing/no explanation for some words and Analogy to a known word for some other. This second type of justification was assigned to the participants who said that for some words they guessed the pronunciation or they did not give an explanation while for others they said that thought of another word that they knew in order to find the correct pronunciation of the target word.

3. Analogy to a known word. The participants that answered that they thought of another word in order to read the target word were assigned to this justification. The difference between this justification and the previous one is that in this justification for every target word the participant thought of a known word while in the previous one the participant did this only for some of the target words.

e.g. *Kostas 7 years 2 months (2nd grade)*: "I read it (the non-word "αυτόλατος") as /aftolatos/ and not as /avtolatos/ because I know the word "aftomatos" which is similar".

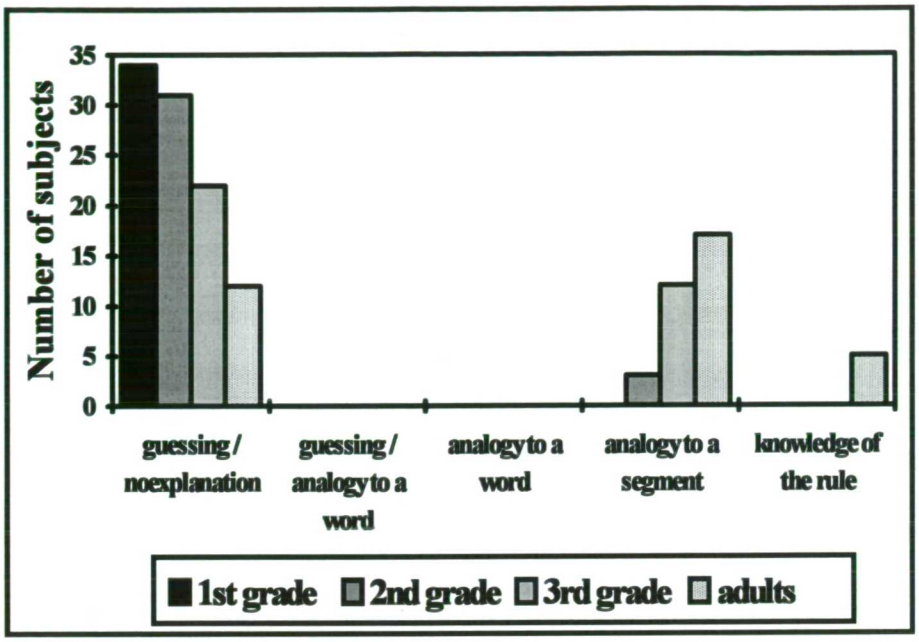
4. Analogy to a critical segment of a known word. Participants that were assigned to this justification said that they had thought of a known word but they only referred to the segment of this word that contained the αυ-ευ combinations.

e.g. *Panayiotis 8 years 9 months (3rd grade)*: "I read it (the non-word /καυτάλι/) as /kaftali/ and not as /kavtali/ because I know the word "aftos" (a real word "αυτός") so I know that the "αυτ" is pronounced as /aft/ and not as /avt/".

5. Knowledge of the rule. Lastly, this justification was given to participants who said that they knew the rule and stated it.

Figure 3.8 shows that only five adults knew the rule for the αυ-ευ combinations. All

not-analogous non-words



analogous non-words

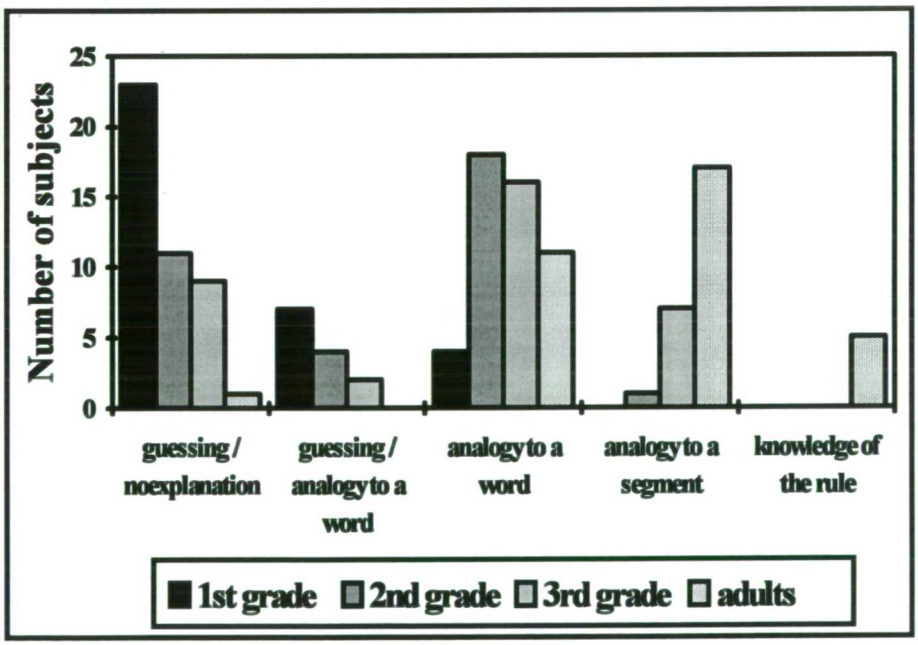


Figure 3.8
Number of participants assigned to each justification by grade for αυ-ευ combinations

N=34 for each age group

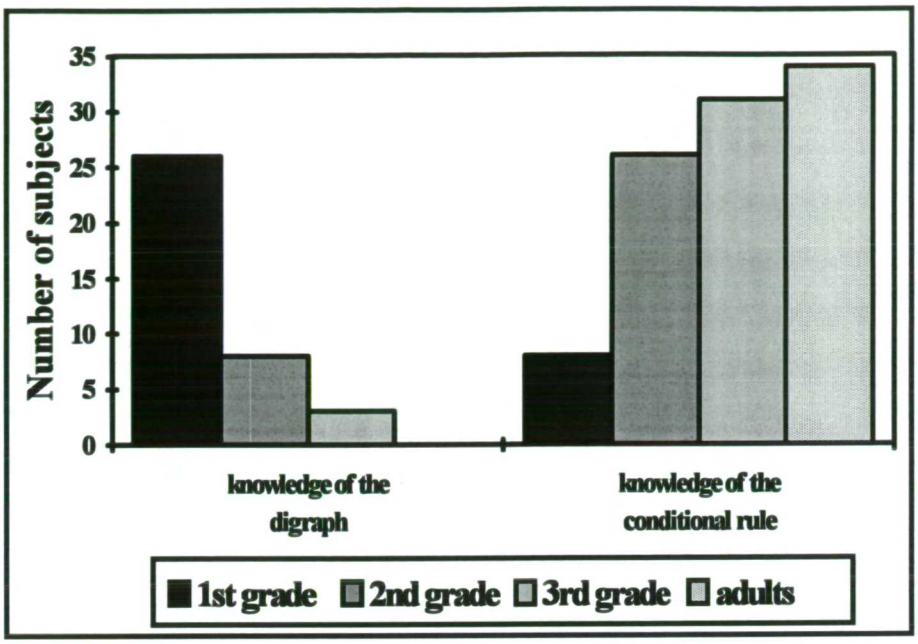
the other participants either guessed the pronunciation of the non-words or used analogy. For the not analogous non-words only 17 adults, 12 third graders and 3 second graders said that they thought of a segment of a known word in order to find the correct pronunciation of the not-analogous non-words. In contrast, 17 adults, 7 third graders, and 1 second grader said that they thought of a segment of a real word in order to find the correct pronunciation of the analogous non-words.

For the not-analogous non-words 12 adults, 22 third graders, 31 second graders and 34 (all) first graders said that they guessed the pronunciation. Conversely, only 1 adult, 9 third graders, 11 second graders and 23 first graders said that they guessed the pronunciation of the analogous non-words. In the analogous non-words 11 adults, 16 third graders, 18 second graders and 4 first graders said that they thought of a known word in order to read the non-word. Another 2 third graders, 4 second graders and 7 first graders said that sometimes they guessed the pronunciation and some times they thought of a known word. These two last categories did not appear in the not-analogous non-words because there was not a real word from which they could analogise the pronunciation of the non-word.

3.III.d.2. Justifications for Vowel Cluster Tonos and Vowel Cluster Dialitika

Only two justifications were found for the vowel cluster (tonos and Dialitika) conditional rules. In this group of words, the participants either knew the rule and they stated it or they did not know the rule and they read the vowel clusters as digraphs. It has to be mentioned that some children who knew the rule read some of the non-words wrongly. When they were asked to justify their reading they corrected themselves. Similarly, when children who did not know the conditional rule read some non-words correctly and they were asked to justify their reading they corrected themselves and read the vowel cluster as a digraph (i.e. wrongly).As Figure 3.9 shows, only 26 first graders, 8 second graders and 3 third graders did not know the

vowel cluster tonos



vowel cluster dialitika

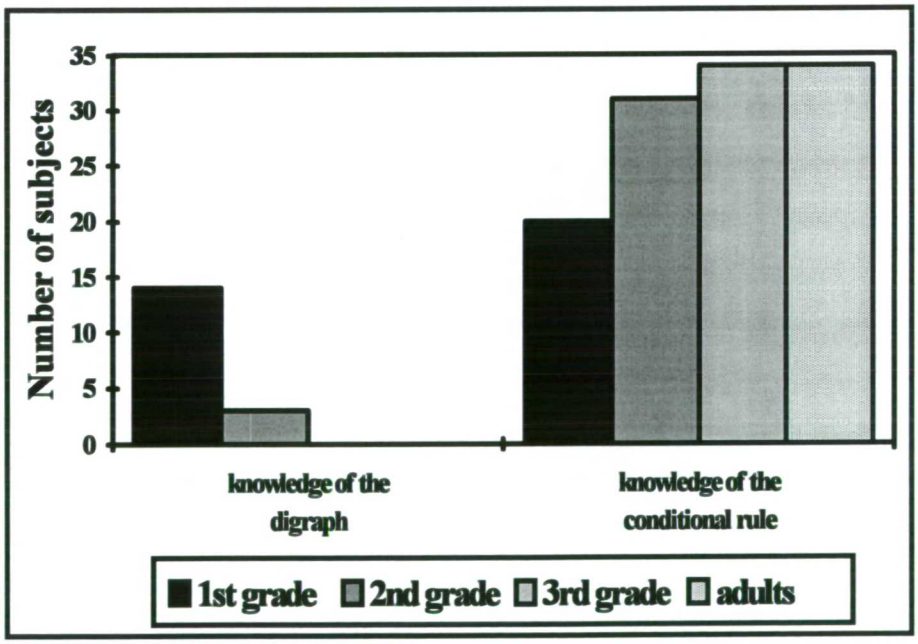


Figure 3.9
Number of participants assigned to each justification by age for the vowel cluster tonos and vowel cluster dialitika conditional rules
N=34 for each age group

vowel cluster tonos conditional rule. For the vowel cluster dialitika conditional rule only 14 first graders and 3 second graders did not know the rule. Even though such a large number of children knew those conditional rules, these two categories of words were the most difficult ones for all the age groups but the adults.

3.IV. Discussion and Conclusions

3.IV.a. Summary of the results

1. There were significant age differences between the four age groups. In general, younger children performed worse than older children and adults, showing a developmental progression.

2. There were significant differences between the children's and adults' performance in the three conditional rules. For children, vowel cluster dialitika conditional rule was the most difficult one and the αυ-ευ combinations the easiest one. For adults, the latter was the most difficult (only for the not-analogous non-words) while there was no significant differences between their performance in the two vowel cluster conditional rules.

3. There were significant differences between analogous and not-analogous non-words for children in all the three conditional rules. For adults significant differences between analogous and not-analogous non-words were found only for the αυ-ευ combinations.

4. All the children and adults performed better in the real words than in the non-words (both analogous and not-analogous) showing that they did use these words as the basis for making analogies in order to read the analogous non-words.

5. In the control words and non-words children's and adults' performance almost reached ceiling. The small, although significant differences, for the second graders are not indicative that these children used the strategy of analogy in the reading of these words and non-words.

6. Children's and adult's justifications showed that the two vowel cluster conditional rules are learned quite early. Second and third graders clearly stated the grammatical rule. The αυ-ευ combinations conditional rule was not learned even by adults. Only five adults stated the grammatical rules. However, both children and adults used inferences and analogies to read the non-words that involved this conditional rule and they clearly stated their strategy.

In the next section, these results are discussed in more detail in relation to each of the hypothesis of the study.

3.IV.b. Discussion of results

Hypothesis 1: All the conditional rules are not mastered at the same time.

As in the previous experiment there were significant differences between children's and adults' performance in the three conditional rules. The results confirmed the hypothesis that different conditional rules are mastered at different time. It was also revealed that children use different strategies in reading words that involve different conditional rules. The vowel cluster tonos conditional rule was the most difficult one for children. From the analysis of justifications, however, it was found that from second grade onwards the vast majority of children know this conditional rule. Only eight second graders and three third graders did not know the rule. Vowel cluster dialitika conditional rule is easier than the vowel cluster tonos but harder than the αυ-ευ combinations. However, only 14 first graders and three second graders did not

know this rule. Two possible explanations for these results are offered.

Firstly, when Greek children start reading, in the first grade, they are first taught the sounds of single letters. What they are taught to do is to associate one letter with one sound. As has been shown in the first experiment a simple sequential strategy, one sound for one letter, is used during this period quite effectively. After, the teaching of the single letters, still in the first grade, the children are taught the digraphs and double letters. This is in contrast to what they have learn so far. When they are introduced to digraphs and double letters the children realise that a simple sequential strategy, one sound for one letter, is not enough for reading. A new, more complex, sequential strategy that takes into account the two-to-one relations between graphemes and phonemes is developed by children. It has been shown in the previous study that even first graders have acquired this strategy since they had no particular problems in reading words and non-word with digraphs and double letters.

After single letters and digraphs the children are taught that there are some words where the two letters that represent a digraph are not pronounced as one sound but separately. A phonological strategy that pays attention to two characteristics must be used for the reading of these words. Firstly, children have to note whether the two letters are together in the word. Secondly, they have to note whether the stress mark is on the first letter or a diacritic mark (dialitika) is on the second letter. If neither of them is true then the two letters represent a digraph. If one of them is true then the two letters represent two different phonemes. In order for these procedures to take place children must know that there are two possibilities for the pronunciation of the two letters when they appear together: either they represent a digraph or two different letters. If children do not know one of them there is no need to process the word using this strategy. However, the results show that young children, even if they know the two possibilities, cannot pay attention to both characteristics. They usually stop at the first procedure that controls for the digraphs. It is after the third grade that

children can take into account both the characteristics and can read both words and non-words that involve these conditional rules. However, when readers develop this strategy completely they have no difficulty in reading these words. This is clearly demonstrated by adults' performance.

A second explanation for these results is that the two clusters represent a digraph more frequently than they represent two separate letters. Children, especially at the beginning of their reading development, with limited reading experience, are used to reading these vowel clusters as digraphs and forget to pay attention to the stress mark or on the dialitika although they know the conditional rule. As children read more words that involve the two conditional rules, they start to pay attention to both the stress mark and the dialitika.

It has to be mentioned that when children who knew the conditional rules for the vowel clusters were asked to justify their reading of a non-word that was read incorrectly, they corrected their reading and stated the rule. When children who did not know the conditional rules were asked to justify their reading of a non-word that has been read correctly, they changed their reading by saying that these two letters represent a digraph and not two separate letters.

The results showed that there are significant differences between children's performance in vowel cluster tonos and vowel cluster dialitika conditional rules. This result can be explained on the basis of the different functions that each of these marks serve. Stress is a phonemic distinction in Greek, where two identical sequences of sounds with different stress are different words (e.g. "νόμος" /nomos/ and "νομός" /nomos/, mean "law" and "prefecture" respectively). Its main purpose is to signify the stressed segment of the word (the segment at which the tone of the voice must be raised). In the vowel clusters when the stress mark is on the first letter it indicates that the two letters are pronounced separately while when it is on the

second letter it indicates that the vowel cluster represents a digraph. The diacritic mark dialitika, however, has only one function: it appears only in some words and it indicates that the two letters of a vowel cluster are pronounced separately. The multiple functions that the stress mark serves in contrast to the one function that the dialitika mark serves might explain the difference between the two conditional rules that involve vowel cluster tonos.

A second interesting result is that the αυ-ευ combinations are the easiest conditional rule for children although grammatically it appears to be rather complex. Firstly, it has to be mentioned that no child knew this conditional rule. Even adults did not know this conditional rule. Only five out of 34 stated the rule. Secondly, there are more words that involve those two combinations than the two vowel clusters where the two letters are pronounced separately. Hence, children right from the beginning of their reading development have considerable experience with words that involve the αυ-ευ combinations which does not happen with the other two conditional rules. Thirdly, this was the most difficult conditional rule for adults and the only one in which their performance did not reach a ceiling level. Lastly, in the αυ-ευ combinations children right from the beginning are taught that when those two letters appear together they are pronounced either as /af/ or as /av/. It might be easier for children to learn this than to learn that two letters sometimes represent a digraph and at other times two separate phonemes.

The results of the present study have extended the findings of previous researchers by indicating that different conditional rules are learned at different times or they might not be learned at all. This is clearly demonstrated by adults' justifications showing that only a quite small number of them knew the conditional rule for the αυ-ευ combinations. A discrimination between complex and simple conditional rules might be possible, indicating that conditional rules are not learned similarly.

Hypothesis 2. Greek children use the strategy of making inferences or analogies from the pronunciation of known words in order to pronounce unknown words that involve conditional rules.

This hypothesis was supported by the data although not with respect to all the age groups and all the conditional rules. Adults did not use analogy in reading the words that involved the two conditional rules for the vowel clusters. As it was shown from their justifications, they have learned these conditional rules. For the αυ-ευ combinations conditional rule adults did make analogies and inferences from the pronunciation of known words in reading both analogous and not-analogous non-words. This is shown from the significant differences between their performance in analogous non-words and not-analogous non-words.

Their justifications showed that analogies that were based on whole words were used for the reading of analogous non-words while inferences that were based on critical segments which were shared by the known word and the unknown non-word were used for the reading of both analogous and not-analogous non-words. This second strategy indicates that adults have understood that the letter that follows the combinations is important for their pronunciation. It is an expression of the conditional rule. Not all the adults however, used this strategy and this explains the significant difference between analogous non-words and not-analogous non-words. This is also indicated in their justifications where 12 adults said that they guessed the pronunciation of the not-analogous non words, while only one gave this justification for the analogous non-words.

Almost all the third graders knew the vowel cluster tonos and the vowel cluster dialitika conditional rules. The significant differences between their performance in words and non-words indicates that they were not yet able to use them effectively yet. It is not only the knowledge of the conditional rule that improves their reading

ability. It might be that reading experience also plays a significant role in children's learning of conditional rules.

It is clear from the results that the third graders can use the strategy of analogy to known words in order to read the unknown words. The results for the differences between analogous and not-analogous non-words clearly support this interpretation. A clearer indication that third grade children spontaneously use the strategy of analogy offers the examination of their justifications. Almost half the third graders that participated in the study clearly stated that they thought of a known word in order to read the non-word. Some third graders also used the strategy of making inferences to a segment of a known word in order to read the unknown word. As with adults, by using this strategy third graders show that they have found a way to express the conditional rule. However, only 25% of the third graders used this strategy a result showing that this strategy is acquired from the third grade onwards.

The vast majority of the second graders knew the conditional rules for the vowel cluster tonos and vowel cluster dialitika. As with third graders the knowledge of the conditional rules does not mean that they can read any word that involve these conditional rules. The results showed that these children can spontaneously use the strategy of making analogies to the pronunciation of known words in order to read unknown words. These children can make analogies to whole words but they cannot yet make inferences from a segment of a known word in order to read an unknown word. Only three second graders said that they used this strategy in reading not-analogous non-words.

Lastly, the findings of the present study, showed that even first graders can spontaneously use the strategy of making analogies to the pronunciation of known words in order to read unknown words. The significant differences found between their performance in analogous non-words and not-analogous non-words is a clear

evidence for that.

It has to be noted that children of all the three grades use analogies to the pronunciation of known words in order to read the non-words even if they did not say that they thought of a known word in order to read the analogous non-words of the vowel cluster conditional rules. The significant differences between their performance in analogous non-words and not-analogous non-words support this observation. No significant differences between analogous and not-analogous non-words were found for the control items showing that children do not use this strategy in reading words that can be read by using a sequential strategy.

The results of the present experiment is inconsistent with Marsh et al.'s (1981) claim that the strategy of analogy is available by stage four of reading development. The findings of the present study showed that even first grade children can spontaneously use the strategy of analogy in reading. The findings of the present study do not support their claim that analogy is an optional strategy even for adults and its use depends on task factors. The results of the present experiment extended those of previous researchers by showing that readers do not only use analogies to whole words or to phonological segments such as syllables or onset-rime. Segments that include part of one syllable and part of another syllable can also be used in reading.

3.IV.c. Conclusions and limitations

Study 2 has shown that Greek children do not learn all the complex orthographic conditional rules at the same time. There are conditional rules that are not learned even by adults. Even conditional rules that are learned by children quite early they are not used effectively till quite late. It is not only the rule that children have to learn. The rule is a grammatical statement that can be memorised. What is important is the psychological processes that children use in order to learn the rule. Children

must develop a complex phonological strategy in order to accomplish the rule.

This study provides evidence that readers as young as six years old can make analogies to whole words in order to read an unknown word. This process in relation to reading experience helps children to develop a complex strategy necessary for the reading of words that involve conditional rules. There are, however, conditional rules for which such a strategy is not developed at all. Although readers do not learn the grammatical statement for these rules they develop strategies that allow them to express the rule in their own way. The finding that readers from the third grade onwards use the strategy of making inferences from a critical segment of a known word in order to read a non-word supports this claim.

Lastly, this study provides preliminary evidence that children do not use the strategy of analogy in reading words with constant relations between graphemes and phonemes. For these words a simple sequential strategy is used by children quite effectively.

Although this study has offered evidence for the strategies used by readers in reading words that involve conditional rules it was limited to only children's reading. Other measures such as phonological awareness, morphological awareness, vocabulary knowledge and verbal intelligence in accordance with longitudinal designs could give a clearer picture of how children learn conditional rules. Such a study could also provide some explanations for the learning of conditional rules and the factors that influence this learning. Also a study with more control words could provide stronger evidence that readers use the strategy of analogy only for the reading of difficult words.

Another limitation of the present study is that it does not rule out the possibility that readers use strategies other than analogy in reading words that involve conditional

rules. Thus tasks need to be developed which examine the use of other than a sequential or an analogy strategy, e.g. the use of contextual rules, for the reading of words of different difficulty. The next experiment aimed to examine this possibility.

CHAPTER 4: STUDY 3
WHEN DOES LINGUISTIC CONTEXT IMPROVE CHILDREN'S WORD READING?

4.I. Introduction

The aim of this experiment is to test whether Greek children use contextual cues in reading and for which words. Two opposing views exist in the literature about children's reading. According to the first, children at the beginning of their reading development use their phonological awareness to decode words and to read them. There is evidence that the phonological skills of the children are strongly related to their reading (Bradley and Bryant, 1983; Bryant et al., 1990; Goswami and Bryant, 1990). According to the second view, what matters in reading is meaning. The reader uses the semantic information from the text in order to generate hypotheses or guesses about the text yet to be encountered. Children use contextual cues to infer the meaning of words which otherwise they cannot decipher (Goodman, 1967, 1982; Smith, 1979, 1994). As Goodman argues learning to read is a "psycholinguistic guessing game".

In more recent studies (Tunmer et al., 1988; Tunmer & Hoover, 1992; Rego & Bryant, 1993; Tunmer & Chapman, 1995) it has been suggested that language prediction skills enable children to use contextual cues in combination with incomplete graphophonemic information in order to identify unfamiliar words. Tunmer and colleagues hypothesise that linguistic context is most useful for non-expert readers (beginning and backward readers) who guess rather than read the word and might not recognise it on its own; expert readers rely less on linguistic context for word identification. It may be a strategy that plays a lesser part in reading as children become better readers.

Tunmer and Chapman (1995, experiment 2) examined the contributions of phonological recoding ability and language prediction skill to the identification of unfamiliar exception words in underdetermining sentence context. They gave children exception words to read (e.g. stomach) presented both in isolation and in sentence context. They found that year two and year three children performed better when the words were presented in context rather than in isolation. They also found a significant effect of frequency. What is implicit in Tunmer and Chapman's study is that there is no effects of contextual facilitation for regular words. All the words that were used in this experiment were irregular words. It is possible that the reading of words that can be characterised as regular but cannot be read on the basis of one-to-one correspondence rule (e.g. words that involve digraphs and conditional rules) may also benefit from context.

In the above experiment the sentence context was read to children by the experimenter because less skilled readers with inefficient word recognition processes may not use prior sentence context. The target word was always at the end of the sentence. Thus, words presented in a sentence context were exposed for longer than words in isolation as the experimenter read the sentence. A list of non-words of similar difficulty could be used as controls for this longer exposure; gains from reading words in context had to be significantly above those obtained for the control non-words.

A more general hypothesis is suggested and is examined in the present experiment: that the use of context in reading depends both on the skill of the reader and the difficulty of the word. Young children might not rely on context to improve their accuracy when reading easier, regular words but might show benefits from context when the word cannot be read on the basis of simple one-to-one correspondence. In contrast, expert readers might not depend on context to increase accuracy even when reading more complex words. Thus it should be possible to observe within-subject

and between-subject variation in the use of linguistic context for word reading.

In study 1 it was found that Greek children (even six years old) use quite effectively a sequential strategy in reading. There are, however, some words that cannot be read on the basis of a simple sequential strategy and children even at the age of eight have not yet developed a complex phonological strategy for the reading of these words. These words, although they cannot be characterised as irregular (Treiman, 1993), involve complex contextual rules which violate the one letter for one sound rule. Therefore, if the hypothesis that the use of contextual cues in reading depends on both the skill of the reader and the difficulty of the word , the reading of regular words with one-to-one constant relations between graphemes and phonemes, which poses the least difficulty for beginning readers, should show significantly less benefit from presentation in context than the reading of words which involve complex contextual rules.

4.II. Method

4.II. a. Participants

102 children were participated in this study. The children were equally divided between three age groups: 6 years - grade 1 - (mean age: 6 years 5 months; range: 6 years one month - 6 years 11 months); 7 years - grade 2- (mean age: 7 years 6 months; range: 7 years 1 month - 7 years 11 months); and 8 years - grade 3 - (mean age: 8 years 7 months; range: 8 years 1 month - 9 years). All the children were attending four different public schools in the city of Katerini, in Northern Greece. Children were selected randomly from the register. The children who participated in this study were different from those that participated in the first two studies, although they were from the same schools and the same classrooms. The teacher of

each class was asked to exclude from the list the children who had serious problems with reading. Six children were excluded from the study (all of them from the first grade) because they could not even recognise all the letters of the alphabet. Testing took place in March and April, that is the end of the second term of the school year.

4.II. b. Design

Children from the three first grades were included in the study. In studies 1 and 2, it was found that children in these three grade levels differ significantly in their decoding skills. If the use of context in reading depends on the skill of the reader then improvement in word reading in context must be higher for each younger group.

A reading task was developed that comprised 58 words and 58 non-words randomly mixed in a list. Both words and non-words were presented in isolation and in the context of a sentence. The words were divided into three classes: a) words with one-to-one constant relations between graphemes and phonemes (10); b) words with two-to-one constant relations between graphemes and phonemes (24); and c) words with one-to-one variable relations between graphemes and phonemes (24). If the use of context in reading depends on the difficulty of the word then significant differences between the three classes of words must be found.

All the words used in the study were selected from the reading books of the four initial grades of the primary school and were controlled for frequency. Because there are no frequency counts for Greek, every word from the books was entered in the computer. Frequency tables for each word were produced for each grade level. Not-frequent were counted the words that appeared less than twice in the books of each grade. Because in study 1 it was found that children (even first graders) had no difficulty in reading words that have one-to-one constant relations between

graphemes and phonemes only ten words of this class were included in the task.

The non-words were distributed, similarly to the words, amongst three classes. They were created to look like real Greek words, i.e. to have the endings, the syllable types and the clusters of letters that can be found in Greek. There were no real words that matched the pronunciation and the appearance of the non-words. Non-words were included in the study as controls for the length of exposure. Words in context were exposed longer than words in isolation because the child had to read only the target word while the rest of the sentence was read by the experimenter. To show genuine effects of context, improvement in reading words in context must be greater than that observed for non-words in context: non-words in a sentence benefit from the same length of exposure but not from linguistic context. Table 4.1 summarises the design.

The sentences were constructed to give some clue for the target word but without specifying a particular word. For example, in the sentence "Tom and Mary played football" where the target word is "football", the meaning of the sentence gives some clue that the word must be some kind of game but it does not specify which game. In all sentences the target word or non-word was always at the end of the sentence. In order to be sure that the sentence contexts were underdetermining ones, the 116 sentences were presented in a different sample of 15 children (five from each age-group) as an oral close task. In this task the experimenter said the sentence to the child without the target word, and the child had to supply the word that s/he thought fitted with the meaning of the sentence. The average predictability of the 58 target words was 7.4% which is below the naturally occurring rate of predictability of 10% for content words in running text (Gough, 1983).

The order of presentation of the words and non-words in isolation and words and non-words in sentence context was counterbalanced across children at each grade

Table 4.1

Design of Experiment 3

		word reading	word in sentence Context
Words	One-to-one constant relations	10*	10
	Two-to-one constant relations	24	24
	One-to-one variable relations	24	24
Non-Words	One-to-one constant relations	10	10
	Two-to-one constant relations	24	24
	One-to-one constant relations	24	24

* Number of words used for each variable

level. Using this procedure any effects of prior exposure to the same words can be controlled, although Adams and Huggins (1985) found that the effects of prior exposure on children's reading were small.

4.II.c. Materials and Procedure

All children were individually interviewed in a separate room in their school in two sessions. Each session consisted of reading 116 words and non-words presented either in a sentence context or in isolation and lasted 5 to 15 minutes. All the children read both the words and the sentences. The second session occurred one week after the first session.

One-to-one constant relations words. Words that have one-to-one constant relations between graphemes and phonemes were included in this class of words. The words of this class were equally distributed between two groups: a) those that have simple syllabic structure; and b) those that contain complex syllables.

Two-to-one constant relations words. Words that involve digraphs and double letters were included in this class of words and were equally distributed between three groups: a) those that have a digraph; b) those that have a consonant digraph followed by a single consonant and because of that have a complex syllable; and c) those that have a double letter.

One-to-one variable relations words. Words that involve conditional rules were included in this class of words and were equally divided into three groups: a) words that involve the αυ-ευ combinations conditional rule; b) words that involve the vowel cluster tonos conditional rule; and c) words that involve the vowel cluster tonos dialitika conditional rule. The three conditional rules have been explained in previous chapters.

Non-words were created so that to present all the variations applied to the real

words.

When the children were asked to read the words and non-words in isolation the following instruction was used: "Today, I want you to read some words. Some of them are easy to read but some of them are really hard, even for older people. Some of them are not real words that's why they do not make sense. Try your best to work out what the word is". There was no stopping rule and all the children read all the words and non-words.

When the words and non-words were presented in the context of a sentence the children were told: "Here are some sentences. I want you to read silently along with me as I read the sentence to you. In each sentence there is going to be one word that I am going to point to and ask you to read". Then the procedure was exactly the same as for the words in isolation.

Words in isolation and words in sentence context were presented in lower case, in font size 16 on A4 paper, fifteen per page (the list of the words and non-words that children read is presented in Appendix 3). All interviews were tape recorded. During the interview the experimenter had a different sheet, similar to the one the child had, and he marked the mistakes that the child made, out of the child's sight.

4.III. Results

The results are presented in three sections. In the first section the coding procedure and children's overall performance are presented. The second section concentrates on replicating the results of Experiment 1 that the three classes of words and non-words pose different difficulty on children's reading requiring the use of different strategies by comparing children's performance in the classes of words and non-

words. In the last section the hypothesis that the use of context depends on both the reading ability of the reader and the difficulty of the word is examined by comparing children's performance in the words and non-words read in isolation and in the context of a sentence.

4.III.a. Descriptive Statistics

The data that have been obtained were coded as correct (1) and as wrong (0). As with the previous experiments (1 and 2), a value of 2 was given to the children that corrected themselves straight after their first attempt at reading the target word / non-word. These 2 values were recoded as 0, 1, and .5. The three identical analyses that were carried out produced similar results. Hence, the decision was to present here the results of the analysis in which the 2 values were recoded as .5.

Cronbach's Alpha for item analysis on additive scales reliability analysis was carried out for the items in the list. The analysis showed that all the items - except words and non-words with constant relations between graphemes and phonemes which had no variance - were high reliable (Alpha >.97).

Total scores for each group of words and non-words presented both in context and in isolation were computed. The maximum score possible was 24 for the two-to-one constant and one-to-one variable relations words and non-words and 10 for the one-to-one constant relations words and non-words; adjusted scores were used in the analyses in which these variables were included). The differences between the mean scores were analysed using Anovas with repeated measures across categories of words, and age as between factor. Mean scores, standard deviations and distributions were examined. Mean scores and standard deviations are given in Table 4.2. As it can be seen from this Table children's performance in the one-to-one constant and two-to-one constant relations words and non-words was quite high both when the

Table 4.2

Mean Scores and Standard Deviations for all the Variables

			word reading		word in sentence context	
	One-to-one		9.82***			9.89***
	Constant Relations		Total		Total	(.31)
Words	Two-to-one		50.42	23.35**	53.33	23.56**
	Constant Relations		(7.12)*	(.88)	(5.07)	(.83)
	One-to-One	Total		17.24**	Total	19.88**
	Variable Relations	93.36		(6.37)	96.23	(4.40)
	One-to-one	(13.70)		9.62***	(11.94)	9.60***
	Constant Relations		Total	(.65)		Total (.68)
Non-	Two-to-one		42.94	22.42**	42.90	22.25**
Words	Constant Relations		(7.31)	(1.66)	(7.63)	(1.88)
	One-to-One			10.91**		11.05**
	Variable Relations			(5.92)		(5.97)

* Standard Deviation in Brackets

** Maximum Score = 24

*** Maximum Score = 10

Maximum total score for words and non-words = 58

Maximum total score for word reading and word in sentence context = 116

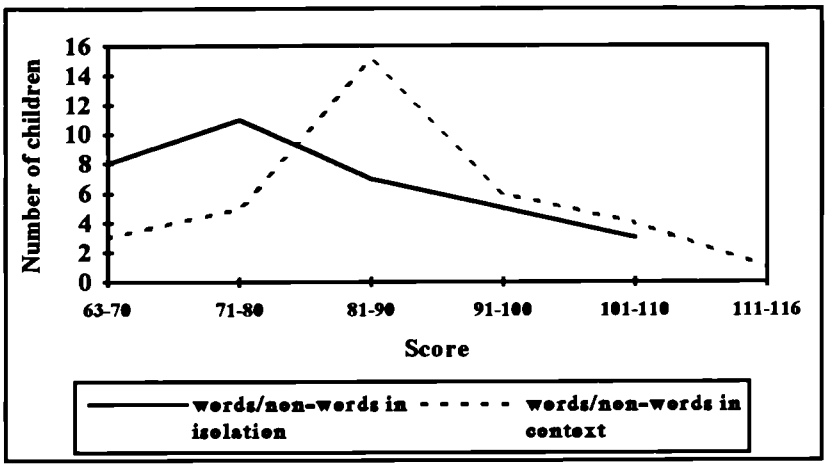
words and non-words were presented in isolation and in the context of a sentence. For the one-to-one variable relations words and non-words children performed worse than the other two classes. Context seems to improve children's reading of this class of words while the difference between words presented in isolation and words presented in context is not large for the other two classes. Figure 4.1 present the distribution of scores in the task. As can be seen from this Figure the distribution of scores is approximately normal and this indicates that a good level of discrimination was obtained.

4.III.b. Are words that require simple sequential strategies mastered earlier than words that require more complex phonological strategies?

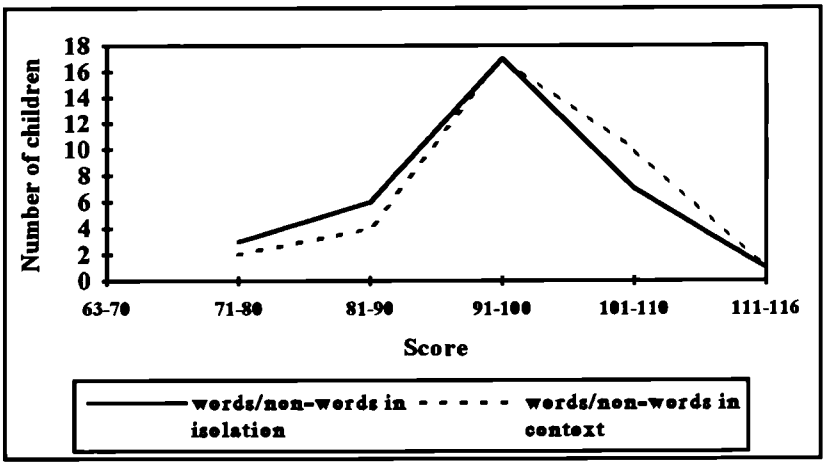
The analysis presented in this section was carried out in order to replicate the results of study 1. In this study it was found that Greek children acquire first a simple sequential strategy and later on they develop more complex strategies. This conclusion was based on the significant differences between children's performance in the reading of words of different classes. The prediction is that children's performance will follow a similar pattern in this experiment showing significant differences between children's performance in the one-to-one constant, two-to-one constant and one-to-one variable relations classes of words.

A 3 X 3 X 2 (age (3: 6 year-olds, 7 year-olds & 8 year-olds), class of words (3: one-to-one constant relations, two-to-one constant relations & one-to-one variable relations) and type of words (2: words and non-words) Analysis of Variance was carried out, with repeated measures on the last two factors. Mean scores are presented in Figure 4.2. As can be seen from this Figure children performed better in words with constant relations than in words with variable relations between graphemes and phonemes. It can also be seen that children's performance improved with age.

Grade 1 (6 years old)



Grade 2 (7 years old)



Grade 3 (8 years old)

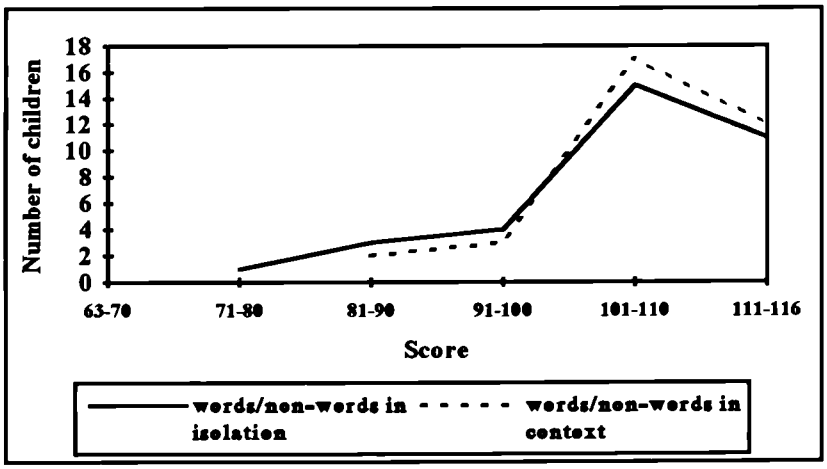


Figure 4.1
Frequency distribution of scores by condition for each age group
N = 34. Maximum score = 116

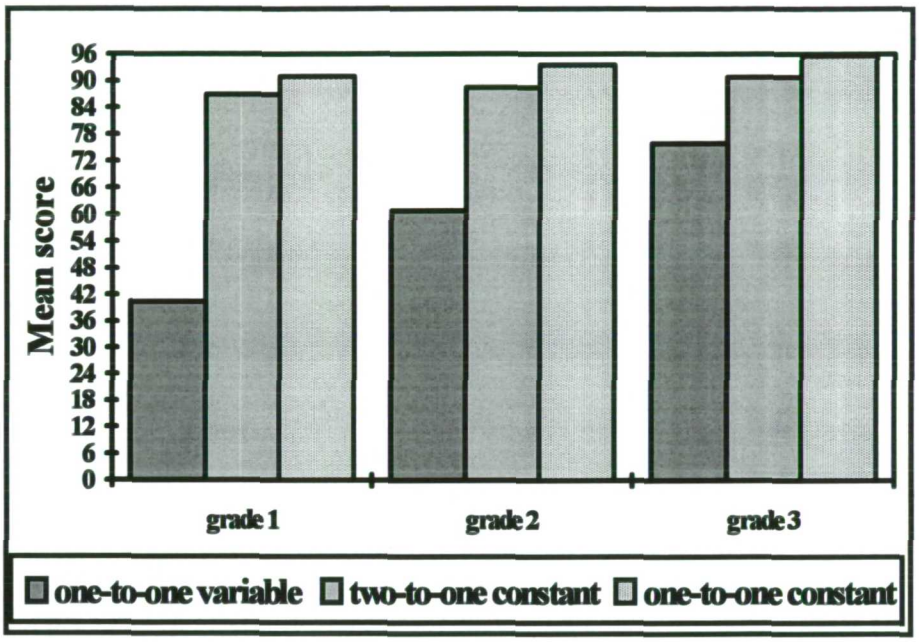
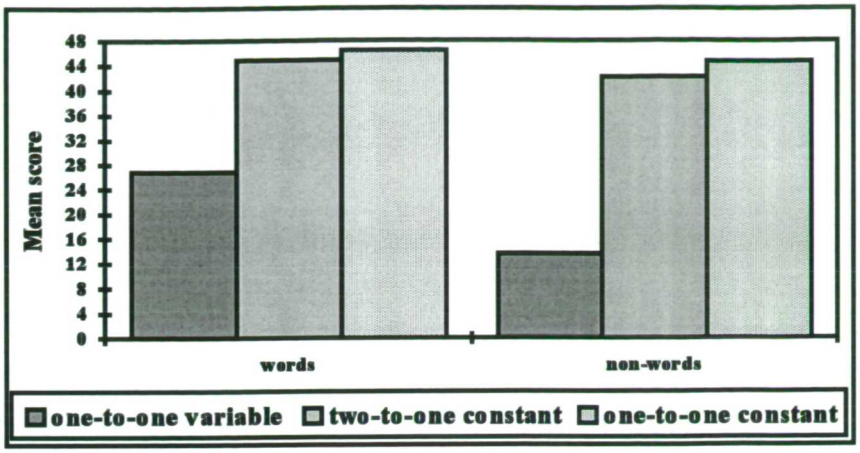


Figure 4.2
Mean number of correct responses by grade and class of words
Maximum score = 96

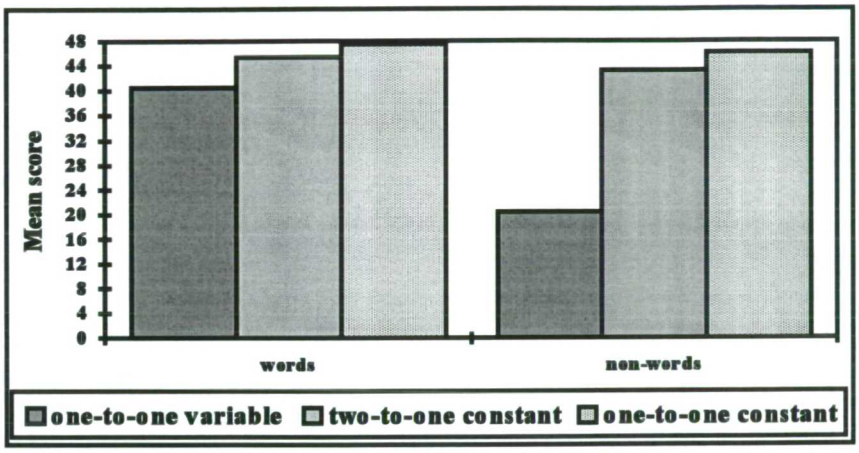
The main term of age was significant ($F(2,99)=44.11$, $p<.001$). Post hoc (Newman Keuls) test revealed that all the comparisons were significant ($p<.001$). The class of words factor was also significant ($F(2,198)=511.46$, $p<.001$). A subsequent Newman Keuls test showed that one-to-one variable relations words were significantly harder than the other two categories of words ($p<.001$), and two-to-one constant relations words were significantly harder than one-to-one constant relations words ($p<.001$). This is also illustrated in Figure 4.3. The two-way interaction age by category of words was also significant ($F(4,198)=40.81$, $p<.001$). The analysis showed that non-words were significantly harder than words ($F(1,99)=555.87$, $p<.001$). Figure 4.3 demonstrates this result. The class by type of words interaction was significant ($F(2,99)=15.40$, $p<.001$). The two way interaction between class of word and type of words was also significant ($F(2,198)=507.31$, $p<.001$). Lastly, the three way interaction age by class of word and by type of words was significant ($F(4,198)=94.83$, $p<.001$). Post hoc (Newman Keuls) test showed that there was no significant difference between one-to-one constant relations words and non-words for the third graders ($p=.056$).

The results of the present experiment replicated those of experiment 1 for the differences between the different classes of words. These results showed that Greek children, by age three, have completely acquired a sequential strategy that allows them to read words and non-words with constant relations between graphemes and phonemes. However, even grade three children have not yet acquired completely a complex phonological strategy that would allow them to read words and non-words that involve conditional rules. Children's development shows a developmental progression. This is clearly demonstrated by the significant age differences. As children develop, their decoding skills (as they can be seen in children's performance in non-words) they use more complex strategies for their reading. A developmental sequence from simple to complex rules is evidenced from the significant differences between children's performance in the different classes of

grade 1 (6 years old)



grade 2 (7 years old)



grade 3 (8 years old)

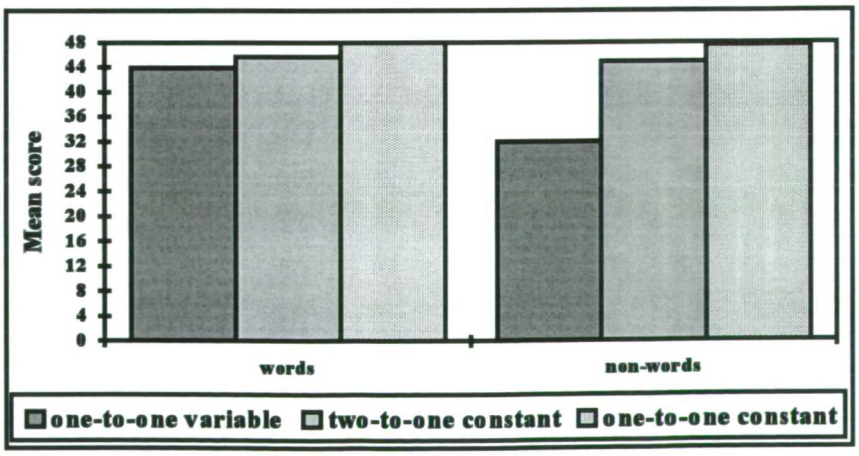


Figure 4.3
Mean number of correct responses by class of words and condition for each age group

Maximum score = 48

words and non-words.

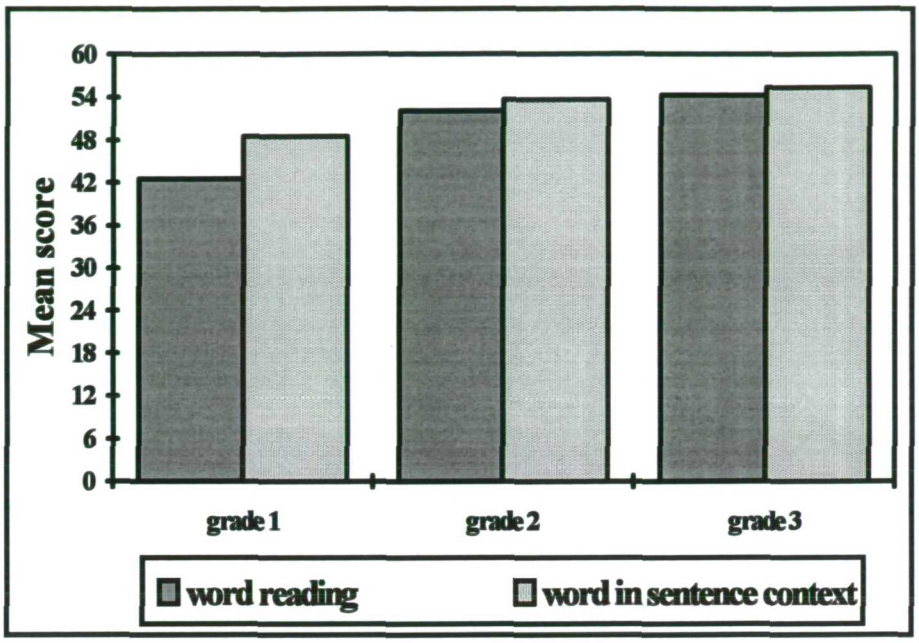
4.III.c. Does the effect of context in reading depend on the skill of the reader and the difficulty of the word?

It was hypothesised that Greek children use contextual cues in reading but the effect of context in reading depends both on the skill of the reader and the difficulty of the word. It was expected that younger children would benefit more from context than older children. It was also expected that the effect of context would be larger for more difficult words (e.g. for two-to-one constant relations and one-to-one variable relations words). A significant interaction between word class and readers' age was also predicted. It was also predicted that improvement in reading words in context would be greater than that observed for non-words in context.

Mean numbers of correct responses were subjected to a mixed Analysis of Variance in which the age (3: 6 year-olds, 7 year-olds, 8 year-olds) was the between subjects factor and class of words (3: one-to-one constant, two-to-one constant and one-to-one variable), condition (2: words in isolation, words in context) and type of words (2: words, non-words) were the within subjects factors. Mean score are presented in Figure 4.4. This Figure shows that children performed better when the words were presented in the context of a sentence than when in isolation. For the non-words there are small differences between non-words in isolation and non-words in a sentence context with children performing better in the former than in the latter.

The main term of age was significant ($F(2,99)=44.11$, $p<.001$). A subsequent post hoc (Newman Keuls) test established that all the comparisons were significant (see Figure 4.4). The class of words term was significant ($F(2,198)=511.46$, $p<.001$) and the two way interaction age by class of words was also significant ($F(4,198)=40.81$, $p<.001$). This analysis has been presented in more detail in the previous section. The

words



non-words

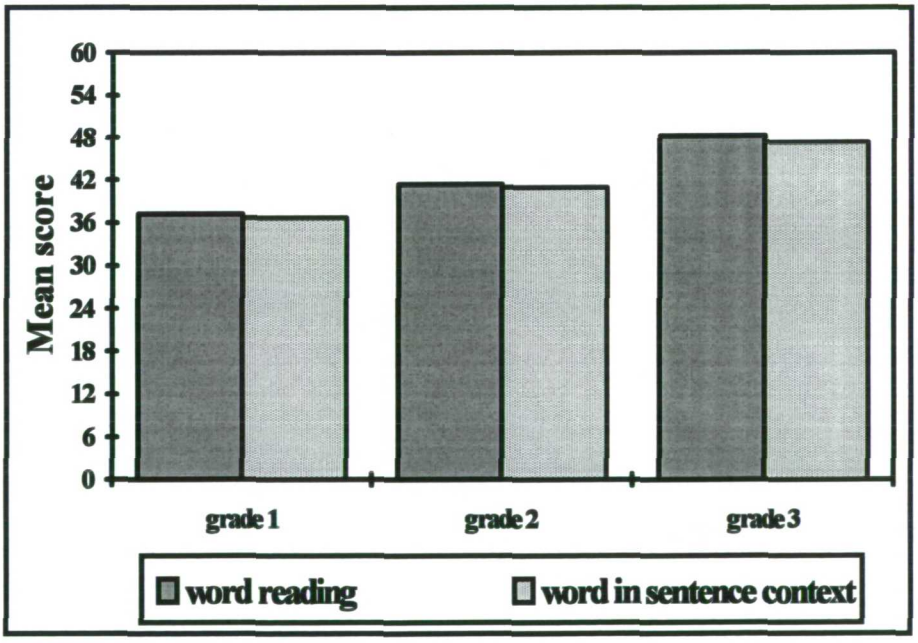


Figure 4.4
Mean number of words read correctly by age and condition for words and non-words

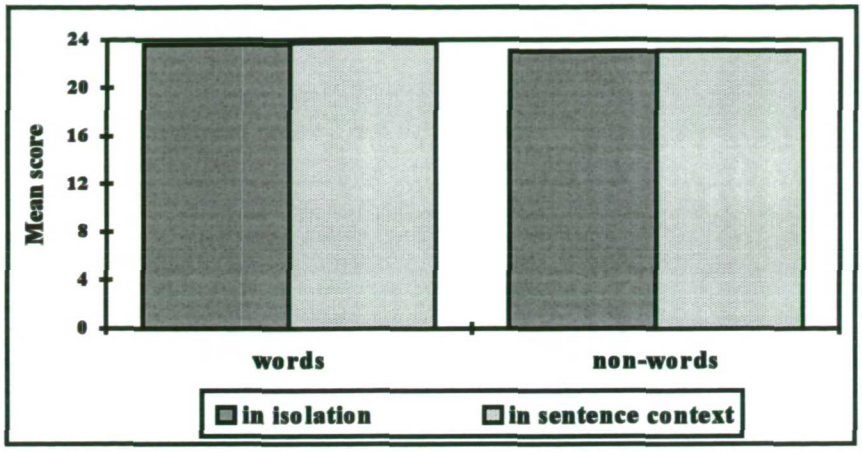
Maximum score = 58

analysis showed that words presented in isolation were significantly harder than words presented in sentence context ($F(1,99)=555.87$, $p<.001$). The age by condition interaction was significant ($F(2,99)=15.40$, $p<.001$). This can also be seen in Figure 4.4. Children performed significantly better in words than in non-words ($F(1,99)=36.68$, $p<.001$). The two way interactions age by type of words and class of words by type of words were significant ($F(2,99)=11.37$, $p<.001$ and $F(2,198)=45.55$, $p<.001$). The three way interaction age by class of words by type of words was also significant ($F(4,198)=5.32$, $p<.001$). The differences between children's performance in the three classes of words and between words and non-words were explored in the previous section.

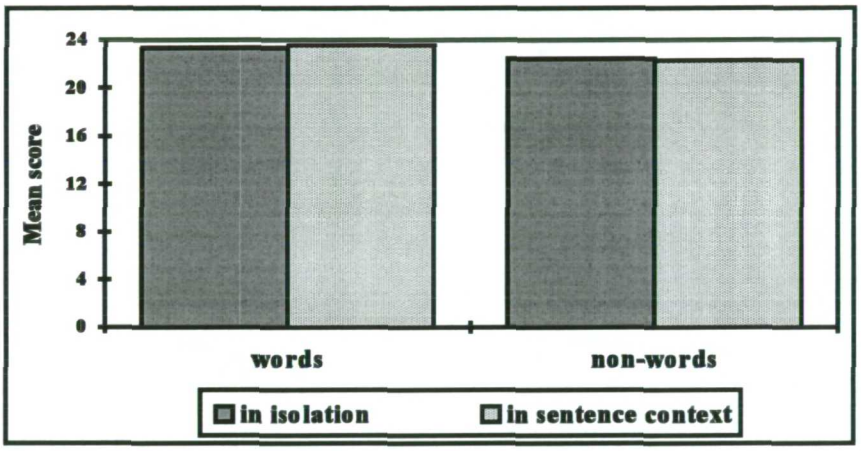
The two way interactions, class of words by condition and type of words by condition were significant ($F(2,198)=507$, $p<.001$ and $F(1,99)=75.95$, $p<.001$, respectively); the three way interaction class of words by type of words by condition was significant ($F(2,198)=41.40$, $p<.001$). These interactions were explored using post hoc (Neuman Keuls) tests. The results showed that there were no significant differences between words in isolation and words in sentences for the one-to-one constant relations class of words. However, significant differences between words in isolation and words in sentence context were found for the two-to-one constant and one-to-one variable relations classes of the words ($p<.05$ and $p<.001$ respectively). The results also showed that there were no significant differences between non-words presented in context and non-words presented in isolation for any of the three classes of words ($p=.707$ for the one-to-one constant relations non-words; $p=.186$ for the two-to-one constant relations non-words; and $p=.561$ for the one-to-one variable relations non-words). These interactions are presented in Figure 4.5.

The three way interactions age by class of words by condition and age by word type by condition were significant ($F(4,198)=47.41$,$p<.001$ and $F(2,99)=17.28$, $p<.001$) respectively). Post hoc (Newman Keuls) tests showed that there were no significant

one-to-one constant



two-to-one constant



one-to-one variable

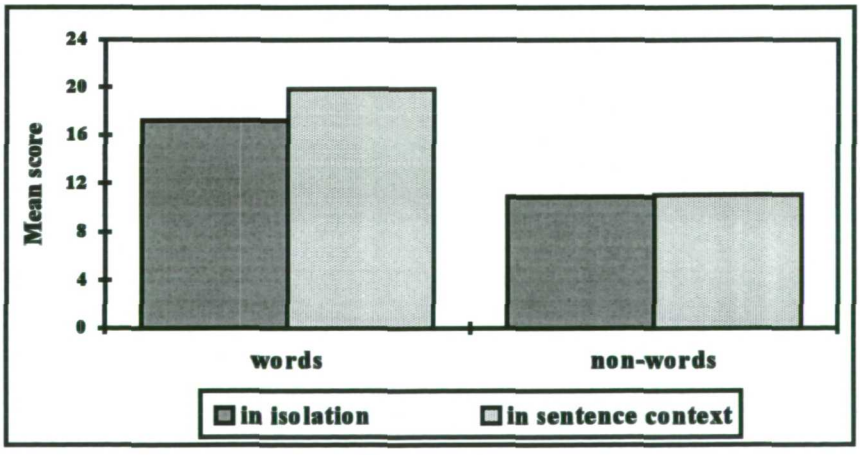


Figure 4.5
Mean number of words read correctly by condition for the three classes of words and non-words

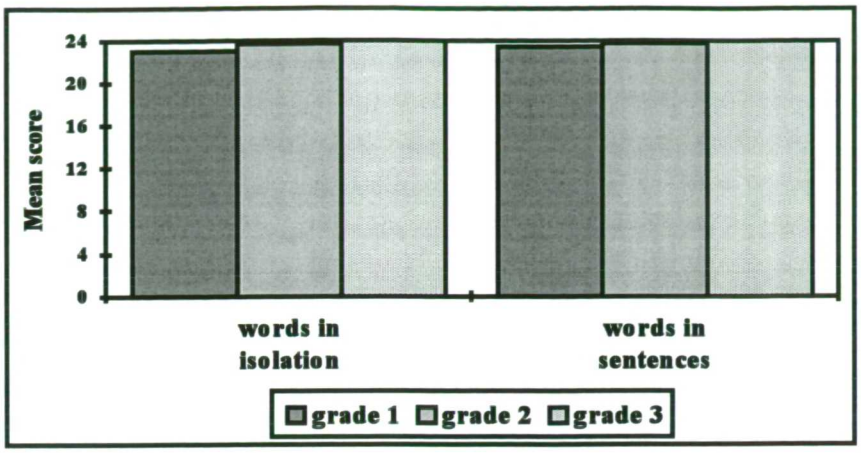
Maximum score = 24

differences between non-words in isolation and non-words in sentences for any of the three age groups in any of the three classes of words. Post hoc tests also showed that for the first and second graders only in the one-to-one variable relations class of words there were significant differences between words presented in isolation and in sentence context ($p<.001$ and $p<.005$ respectively). For the first graders there were no significant differences between words in context and words in isolation for the one-to-one constant relations class of words ($p=.056$) but there were significant differences for the two-to-one constant relations and one-to-one variable relations classes of words ($p<.01$ and $p<.001$ respectively). Figure 4.6 presents these interactions.

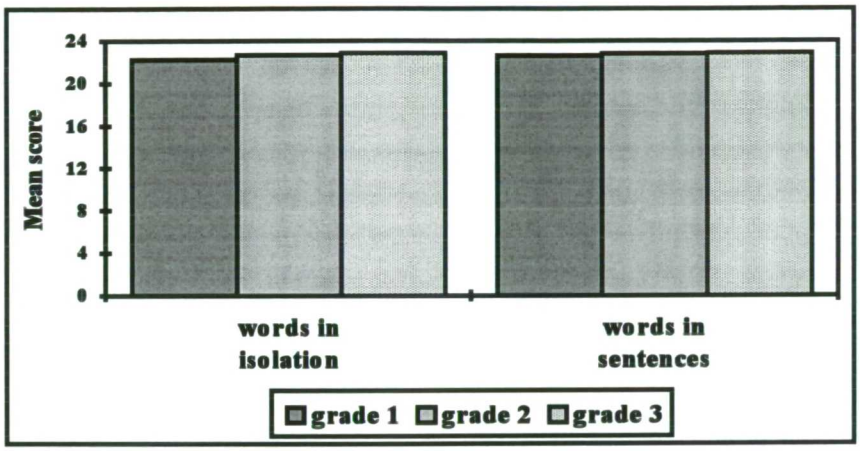
Lastly, the four way interaction age by class of words by condition by type of words was significant ($F(4,198)=21.51$, $p<.001$).

In summary, the results showed that in reading words with constant relations between graphemes and phonemes children do not use contextual cues. These words can be easily read by a simple sequential strategy. However, when the decoding skills required for the reading of a word surpass those available to the reader, as in the one-to-one variable relations words, children use contextual cues in reading. The significant interaction between age and condition showed that younger children benefited more from context than older children. Lastly, a genuine effect of context on word reading was demonstrated since there were no significant differences between non-words in isolation and non-words in sentences.

one-to-one constant



two-to-one constant



one-to-one variable

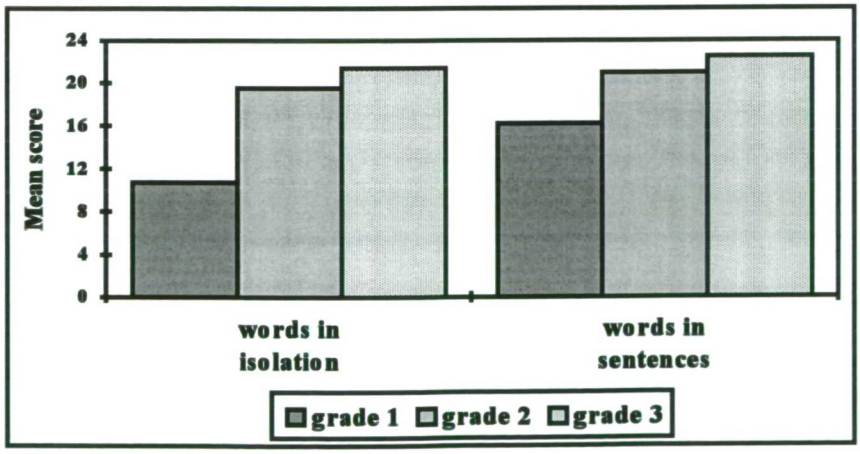


Figure 4.6
Mean number of words read correctly by condition and age for the three classes of words

Maximum score = 24

4.IV. Discussion and Conclusions

4.IV.a. Summary of the results

1. Words and non-words with one-to-one constant relations between graphemes and phonemes were easier than words with two-to-one constant relations and words with one-to-one variable relations. The latter class of words was the most difficult one for children of all the grade levels. Children's performance in all the grade levels was quite high in the classes of words and non-words that involve constant relations between graphemes and phonemes but not in the class of words and non-words that involve conditional rules. There was no significant difference between words and non-words for the first graders in the one-to-one constant relations class of words. Significant age differences were found.

2. In general children performed better when the words were presented in a sentence context than in isolation.

3. There was no-significant difference between words with one-to-one constant relations presented in isolation and in context for all the age groups.

4. There were significant differences between words with two-to-one constant relations presented in isolation and in context for the first graders but not for the two older age groups.

5. Younger children benefited more from context. The effect of context was greater for more difficult words than for easier words with a significant interaction between age, class of words and context.

6. Lastly, there were no significant differences between non-words presented in

context and in isolation.

In the next section these results are discussed in more detail in relation to each of the hypotheses of the study.

4.IV.b. Discussion of the results

Hypothesis 1: Reading acquisition in Greek shows a developmental progression from simple to complex rules.

The hypothesis was supported from the data. As in study 1, Greek children right from the beginning of schooling use a simple sequential strategy in reading. Words that have constant relations between graphemes and phonemes and can be read on the basis of the one letter for one sound rule are the easiest one for children. Children's decoding skills continue to develop and a more complex phonological strategy is adopted for the reading of words that have digraphs and double letters. Although in these words there are constant relations between graphemes and phonemes the one letter for one sound rule is not applicable since two letters represent one sound. By third grade children have almost completely acquired this more complex phonological strategy.

Children's decoding skills do not seem to have reached the point at which words that involve more complex conditional rules can be read. Even third graders had great difficulty in reading words and non-words of this class. However, grade three children are more advanced than the two younger age groups. These results are consistent with Goswami and Bryant's view that phonological awareness develops through reading and spelling experience. These results replicated the results of study 1.

Hypothesis 2: The effects of context in reading depends both on the skills of the reader and the difficulty of the words.

The results supported the hypothesis of an interaction between word reading ability and the difficulty of the word on the use of context for accuracy of word recognition. Children's reading improved significantly as a function of context only when difficult words were presented and this effect was strongest with the younger children.

Context had no effect on the reading of words with invariant spelling patterns even for the six year olds. Greek children right from the beginning of schooling have developed their decoding skills so as to be able to read almost all the words with one-to-one constant relations between graphemes and phonemes. However, first graders' decoding skills have not yet been developed to a point that words with two-to-one constant or one-to-one variable relations between graphemes and phonemes can be read. Context has an effect on the reading of these words although not similar: the effect of context is greater on the reading of the latter words than of the former.

Seven and eight year old children have developed their decoding skills even more than six year olds. These children can decode words that involve one-to-one and two-to-one constant relations between graphemes and phonemes. Context has no effect on children's reading of these words. However, context has an effect on their reading of words with variable but predictable spelling patterns. The effect of context in reading these words is greater for the seven year old than for the eight year old children, showing that the decoding skills of the latter age group have developed even further.

The results of the present experiment are consistent with Tunmer and Chapman's

(1995) results that linguistic context is most useful for non expert readers (beginning or backward readers) who guess rather than read the word and might not recognise it on its own. The results are also consistent with Rego and Bryant's (1993) view that both children's phonological skills and their sensitivity to the context have an effect on their progress in reading.

In the present study, the findings of previous researchers are extended by showing that context has an effect not only on words with variant unpredictable spelling patterns but also on words with invariant and variant but predictable spelling patterns. In the previous studies the effect of context in word recognition was shown by using only irregular words. In the present study no irregular words were used because there are no irregular words in Greek. Instead regular words that involve different relations between graphemes and phonemes were used and it was found that context has an effect on regular words with variable but predictable spelling patterns. In the present study it was also shown that the effect of context in word reading cannot be attributed to the longer exposure of the word when it was presented in context than in isolation. There were no significant differences between non-words presented in context and in isolation.

4.IV.c. Conclusions and limitations

Study 3 replicated and extended the results of study 1. In study 1, significant differences between the reading of words of different classes were found. However, the tasks of study 1 did not allow for an examination of the use of an alternative to a phonological strategy by children for the reading of words that were found to pose great difficulty in reading. The significant differences between words presented in isolation and words presented in sentence context observed in the present study show that children when encountering words that they cannot decode do use other than phonological strategies which results in an improvement of their reading. In this

study it was shown that the greater the level of the complexity in the graphical representation of phonological sequences, the greater the skill required from the reader. When the decoding skills required surpass those available to the reader, partial decoding can be supported by the use of linguistic context.

Although the present study has offered a good description of reading development in Greek and of the strategies that children use in reading it was limited in looking only at children's reading. Although, children's decoding skills can be observed by looking at their performance in non-words, measures of phonological and linguistic awareness might help us to understand the relation between phonological and linguistic skills and reading better.

In this and in the previous studies the development of reading in Greek has been examined. Reading Greek has been found to be easier than spelling (Porpodas, 1990), because in spelling there are one to many correspondences between phonemes and graphemes. Spelling is not always predictable from phonology but it becomes more predictable when conditional rules based on morphology are considered, though some difficulties still remain. The predictability of pronunciation from print suggests that morphology may play a minimal role in reading although spelling might be a different matter. The use of phonological and morphological strategies in spelling Greek are examined in the next study.

CHAPTER 5: STUDY 4
MORPHOLOGICAL STRATEGIES IN SPELLING

5.I. Introduction

In this chapter the processes involved in the acquisition of morphological spellings are examined. It is proposed that morphological spelling strategies are necessary for spelling in Greek. In spelling, similar to reading, children use first simple strategies and later add more sophisticated strategies (Nunes et al., 1997; Bryant et al., 1997). According to theories of literacy development children go through an alphabetic stage where they learn the basic relationships between letters and sounds and later they reach a more advanced orthographic stage where the higher order, more sophisticated aspects of the nature of the written language are learned (Marsh et al., 1981; Frith, 1985).

Evidence for the existence of an alphabetic stage in spelling comes from the work of Read (1986) and Treiman (1993). In these studies of children's invented spelling it was shown that children concentrate on alphabetic rules when they begin to spell and they tend to represent the sounds of words phonetically. But learning to spell is not just a matter of representing sounds by letters. Although important, this is only a part of becoming literate. Another fundamental part in learning to spell is the link between morphology and script (Bryant et al., 1997; Nunes et al., 1997). In many alphabetic scripts it is impossible to learn to read and spell without taking into account another kind of building block used to form words, the morphemes.

There is a great deal more evidence for the role of morphemes in adult reading than in children's reading or spelling (Morton, 1982; Murel and Morton, 1974, Taft, 1991; Caramazza et al., 1988). According to the multi-level model of processing proposed by Taft (1991), words are visually processed passing through other smaller

units such as syllables and morphemes. According to Nunes and Bryant (1998) a lexical route that works in this way is important for reading and spelling acquisition because it allows children to read or spell novel words which cannot be processed in a lexical route that operates at the level of whole words because in this case every word must have its own representation acquired through specific past experience. In contrast, in a lexical route that operates at the level of morphemes a child who knows that the word "play" is a verb and encounters the word "played", for example, for the first time can recognise the word because the child would have the lexical representation for "play" and a lexical representation for "ed" which is an inflectional morpheme for past verbs (Caramazza et al., 1988).

In recent years some studies have shown how important it is for children to understand the connection between grammar and spelling (Nunes et al., 1997a, b, and c; Bryant et al., 1997a, and b; Totereau et al., 1997). These studies also revealed that this acquisition is not simple and happens over an extended period of time. Nunes et al. (1997), for example, have examined English children's use of the grammatical morpheme "ed" in their spelling. They found that children's acquisition of "ed" follows a developmental sequence which was described in a five stage developmental model in which the five stages were: pre-phonetic, phonetic, a third stage in which children overgeneralised the "ed" ending to non-verbs; a fourth stage in which children generalised the "ed" ending to irregular past verbs, and a last stage in which children wrote "ed" only on the past tense regular verbs.

Bryant et al (1997) have proposed that there are three kinds of link between morphology and writing: (a) deciding between two or more acceptable spelling sequences (e.g. in English, the ending /ks/ can be spelled either as "x" if the word is a singular noun or "cks" if the word is a plural noun); (b) spelling silent morphemes (e.g. in French "maison and maisons" are pronounced the same but are spelled differently because the second case is a plural noun while the first case is a singular

noun); and (c) conventional spellings for morphemes which flout letter-sound correspondence rules (e.g. the "ed" morpheme for the past tense regular verbs is always spelled the same but it is pronounced as /t/, /d/, or /id/ in different verbs).

In Greek, morphology is the key to deciding between alternative spellings for word endings. For example, many words end in the sound /i/ and this ending can be spelled in one of four ways - with single letters "η, ι" or with digraphs "οι, ει". Feminine singular nouns and adjectives take the first of these spellings (e.g. η), neuter singular nouns the second (e.g. ι), masculine plural nouns and adjectives the third (e.g. οι), and third person singular active verbs in one conjugation take the fourth (e.g. ει). These morphemes at the ending of the words convey meaning and also have a grammatical function. Thus, for the reasons that I have just given, it is quite impossible to spell Greek words just on the basis of a thorough knowledge of letter-sound relationships. One needs to use morphological as well as phonological strategies in spelling.

Four questions are investigated in the experiment reported in this chapter. The first question is: where there are alternative spellings of the same sound, do young children start by adopting mostly one of these spelling patterns? In Greek there are instances where there are two or more spellings for the same sound and the grammatical status of the word determines which spelling sequence it should contain. Do young children adopt all the possible spelling patterns either appropriately or inappropriately or do they start by using just one of the alternative spelling patterns and later adopt the others? My hypothesis is that at first, children tend to show a marked preference for one of the alternative spellings. Later on, as they have more experience with reading and writing, they adopt and use the alternative spelling patterns as well.

The second question follows from the first: When Greek children add the alternative

spellings to their repertoire, do they assign the right spellings to the right grammatical categories or, as in English and French (Nunes et al, 1997; Totereau et al, 1997), do they generalise the newly adopted spelling pattern or patterns to inappropriate grammatical categories? My hypothesis is that children do not assign the alternative spellings to the right types of words. Children start by using the newly adopted spelling pattern or patterns without making the necessary morphological connection. They apply the new pattern to inappropriate words as well as to appropriate ones. It is after this intermediary stage, where children learn the alternative spellings but they do not understand the morphological basis for these different spellings, that children start to assign the spelling patterns to the right types of words.

The third question is whether children learn these spelling patterns by rote or make the syntactic and morphological distinctions involved in learning the use of the different spelling patterns. The hypothesis is that children do not learn these spelling patterns by rote. If this hypothesis is correct then the same developmental improvement, as the one observed for the real words, must be found for non-words.

The last question is whether Greek children realise that they can use the spelling of the article to make a choice between different possible endings for nouns and adjectives. Words usually are encountered in sentences, which contain articles. In Greek articles are spelled as 'ο', 'η', 'οι', 'το', 'τα' etc. and in many cases they are in agreement with the ending of the noun or the adjective (verbs do not take an article). My hypothesis is that children use information from the article in order to spell the endings of words instead of using morphological strategies. If this hypothesis is correct then significant differences should be found between tasks where children have to spell both the article and the noun or the adjective and those tasks where the article is provided and the children spell only the noun or the adjective.

5.II. Method

5.II.a. Participants

875 children participated in the study, comprising four age groups: 213 children 7 years old (mean 7;1 range 6;7-7.6), 216 children 8 years old (mean 8;1 range 7;6-8;7), 225 children 9 years old (mean 9;1 range 8;8-9;6) and 221 children 10 years old (mean 10;1 range 9;7-10;6). The four groups were in grades two, three, four and five respectively. The children were sampled from nine different public schools in the city of Katerini in Northern Greece. The intake to these schools varied considerably in socio-economic terms and as a result the sample covered a wide range of socio-economic backgrounds. All the children who participated in the study had learned Greek as their first language.

The study took place in October and November, that is the two last months of the first trimester of the school year. Children were given a spelling task and were seen in one session. Because formal instruction of reading and spelling starts in first grade it was decided not to include first graders in the sample because they could not know all the letters of the alphabet after just one month of reading and spelling instruction.

The teaching of grammar and morphology in Greek is part of Greek language teaching. In children's reading books (of all grade levels) there are exercises aimed at pointing out the differences between the different grammatical classes of words and the different spelling patterns with which each word ending is spelled depending on the grammatical category to which it belongs. The teaching of grammar or morphology is not extensive and no special attempt is made to encourage children to memorise grammatical rules. From the second grade children start learning singular and plural, verbs, nouns and adjectives and gradually, in the grades following, they learn about more complex aspects of grammar and morphology such as passive

voice, compound words, derivatives etc.

5.II.b. Design

A spelling task was developed that comprised 64 words involving three examples of alternative spellings: the final /o/, /ε/, and /i/. The first two can be represented in one or two ways whereas the latter has four alternative spellings. The level of difficulty of these alternative spellings varies because in some cases the phoneme is represented by one letter whereas in others it is represented by a digraph. Eight words for each final spelling were included in the task. Because in Greek most nouns and adjectives are preceded by a definite article that in most cases is spelled similarly to the ending of the word (e.g. η κόρη, /i kori/, daughter) children's spelling might be influenced by the presence of the article. It was decided that children would spell both the article, which always consisted of one or two letters, and the word. A group of 214 children (51 second graders, 53 third graders, 55 fourth graders and 55 fifth graders) spelled these words. A second group of 219 children (55, 55, 53, and 56 in second, third, fourth and fifth grades respectively) spelled the same words but the article was already written for them on the paper. If the presence of the article influences children's spelling then significant differences between the two groups of children must be found. By examining children's spelling of word endings their development of morphological spelling strategies can be observed.

A second list of 64 non-words was created. The non-words were included in the study in order to examine whether children use their grammatical knowledge for the correct spelling of word ending or they learn these spelling patterns through rote learning. A parallel development between words and non-words would be evidence that children do make the syntactic and morphological distinctions involved in learning the endings of the words. The non-words were created to resemble real

Greek words, i.e. to have the syllable types and the clusters of letters that can be found in Greek, and the endings of all of them involved the same three examples of alternative spellings as the real words. Half the group of children spelled both the article and the non-words [221 (53, 55, 58, and 55 in second, third, fourth and fifth grades respectively) children were included in this group]. The second half spelled the same non-words but the article was already written on their paper [221 children were included in this group (54, 53, 59, and 55 in second, third, fourth and fifth grades respectively)].

5.II.c. Materials and Procedure

The spelling task consisted of 64 words. All the words were of low frequency as measured by their appearance in children's reading books. The words were divided into three groups ending in /o/ , /ε/ , and /i/ respectively.

Words ending with the sound /o/. Eight of the words were neuter nouns and therefore their last vowel sound was spelled as 'ο': eight were verbs and so their final vowel was spelled as 'ω'.

Words ending with the sound /ε/. Eight words were verbs in the first person plural of the present tense in the active voice whose final vowel was spelled 'ε': eight words were verbs in the third person singular of the present tense in the passive voice and so their last vowel was spelled as 'αι'.

Words ending with the sound /i/. Eight words were feminine nouns and adjectives in the singular nominative and therefore their last sound was spelled as 'η': eight were neuter nouns in the singular nominative and so their final vowel was spelled as 'ι': eight were masculine nouns and adjectives in the plural nominative whose final vowel was spelled as 'οι': eight were verbs in the third singular person of the

Table 5.1

Number of children by Grade and Task

		Grade (age-range 7-10)			
		2	3	4	5
Spelling Tasks	words with articles	51	53	55	55
	words without article	55	55	53	56
	non-words with articles	53	55	58	55
	non-words without article	54	53	59	55

present tense in the active voice and so their final sound was spelled as 'ει'.

The method that was adopted with each word was to say the word, then to say a sentence which contained the word, and finally to repeat the word on its own ("λερώνει: Ο Σάκης λερώνει εύκολα τα ρούχα του: λερώνει"): the child had the sentence in front of him/her with a blank where the target word was. The child was asked to write the missing word. The reason for including the sentence was to make sure that the child understood the meaning that was given to the word. The testing took place in the classroom and both the classroom teacher and the experimenter made sure that all the children had finished the spelling of one word before going on to the next. The 64 words were presented in random order.

The list of the non-words was presented to the children using the same method as the real words. Non-words were included in the same sentences that were used for the real words and they were constructed so as to represent a verb, a noun, or an adjective ("κεσώνει: Ο Σάκης κεσώνει εύκολα τα ρούχα του: κεσώνει"). Table 5.2 presents some examples of the words, the non-words and the sentences used in this task. All the words, the non-words and the sentences used in this task are presented in Appendix 4.

5.III. Results

The results are presented in five sections. In the first section univariate statistics are described. In the second section the question of whether children start spelling by adopting mostly one of the alternative spellings is examined through the analysis of children's performance in the spelling of the real words task. In the third section the question of whether children assign the right spellings to the right grammatical categories when they add alternative spellings to their repertoire is examined by

Table 5.2

Sample words, non-words and sentences from the spelling task

Real words	Non-words
1. Η τσέπη μου τρύπησε. I've worn a hole in my pocket.	1. Η λάφαρή μου τρύπησε. I've worn a hole in my lafari.
2. Η κατάψυξη του ψυγείου μας χάλασε. Our freezer was broken.	2. Η ατόση του ψυγείου μας χάλασε. Our atosi was broken.
3. Το χωνί ήταν πολύ μεγάλο. The funnel was very big.	3. Το πεφάρι ήταν πολύ μεγάλο. The pefari was very big.
4. Το χαντάκι ήταν πολύ βαθύ. The ditch was very deep.	4. Το φεκότι ήταν πολύ βαθύ. The fekoti was very deep.
5. Οι διάδρομοι του ξενοδοχείου ήταν πολύ μεγάλοι. The corridors in the hotel were very long.	5. Οι λόροι του ξενοδοχείου ήταν πολύ μεγάλοι The lori in the hotel were very long.
6. Οι κόποι της Μαρίας ανταμείφθηκαν. Maria's hard work was rewarded.	6. Οι φερισοί της Μαρίας ανταμείφθηκαν. Maria's ferisi was rewarded.
7. Φοβάμαι όταν αστράφτει. I am afraid of lightening.	7. Φοβάμαι όταν λορίζει. I am afraid of lorizi.
8. Ο Γιώργος παριστάνει το δάσκαλο. George takes off the teacher.	8. Ο Γιώργος σταλένει το δάσκαλο. George staleni the teacher.
9. Το βουητό από την τηλεόραση με ενοχλούσε. The buzzing from the television was annoying.	9. Το βάκαλο από την τηλεόραση με ενοχλούσε. The vakalo from the television was annoying.
10. Αυτό το περιοδικό βγαίνει κάθε εβδομάδα. That magazine comes out every week.	10. Αυτό το κόροσο βγαίνει κάθε εβδομάδα. That koroso comes out every week.

looking at children's spelling of the ending sound of the real words. In the next section the question of whether children learn these spelling patterns by rote or they make the syntactic and morphological distinctions involved in learning the use of the different spelling patterns is addressed by examining children's performance in the non-words and by comparing children's performance in real words and non-words. In the last section the effect of the presence of an article on children's performance is examined by comparing children's performance in the four different types of spelling task.

5.III.a. Descriptive statistics.

The Means and Standard Deviations for each group of children are presented in Table 5.3. When the mean and standard deviations were plotted, a clear linear relationship between these two statistics was obtained (r = .87). This linearity suggests that a logarithmic transformation might be useful. Frequency distribution of the transformed data is presented in Figure 5.1. The distribution of scores is negatively skewed because of the older children's high performance in the task.

5.III.b. Where there are alternative spellings of the same sound, do young children start by adopting mostly one of these patterns?

At the core of this question is the investigation of the existence of a phonetic level in children's spelling development where children are attempting to represent sounds and rely predominantly on one-to-one correspondence rules. It was hypothesised that where there are alternative spellings for the same sound young children at first tend to show a marked preference for one of the alternative spellings. Three examples of alternative spellings were examined. The final /o/, /e/ and /i/. The first two can be represented in one of two ways whereas the latter has four alternative spellings. The level of difficulty of these alternative spellings varies because in some cases the

Table 5.3

Means and Standard Deviations (in brackets) for the spelling task by grade and condition

		Grade			
		Second	Third	Fourth	Fifth
Condition	Words	30.57	43.34	53.67	57.55
		(7.67)	(10.23)	(9.46)	(7.8)
	Words / article provided	36.87	51.36	53.92	59.38
		(10.95)	(9.19)	(9.97)	(7.38)
	Non-words	32.13	44.91	48.14	49.47
		(7.72)	(10.86)	(10.15)	(9.84)
	Non-words / article provided	36.35	41.79	50.37	51.58
		(8.28)	(8.31)	(8.39)	(10.48)

Note: Maximum score = 64

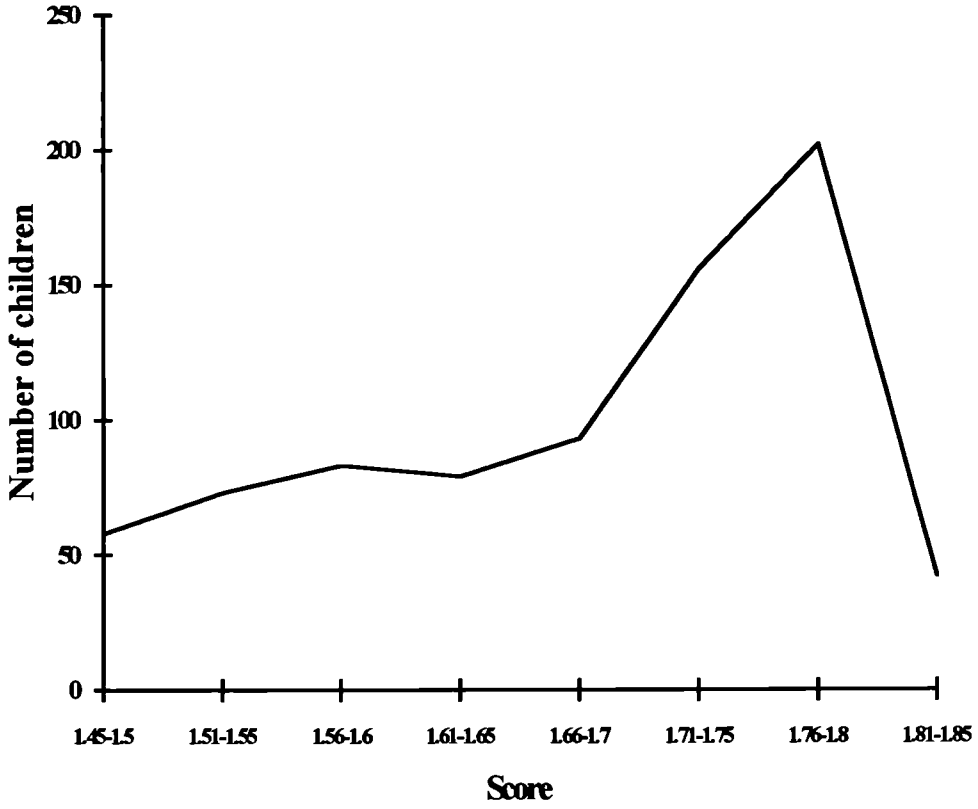


Figure 5.1

Frequency Distribution of transformed scores in the spelling task

N=875

phoneme is represented by one letter whereas in others it is represented by a digraph. It was expected that in all three sounds there will be some children - especially the younger ones - who will use consistently only one of the alternative spellings. In this section only the performance of the 433 children that spelled the real words was examined.

With respect to the final /o/ sound, where both alternatives are single letters and there are only two possibilities, [ω "omega" and ο "omicron"], the criterion used to identify single-letter users was to have spelled 15 out of the 16 words which had been dictated to them with the same letter. This criterion of a maximum of one word spelled with the alternative of the preferred letter (i.e. "ω") was set because children's use of the preferred letter should be significantly different from chance. It was also reasoned that isolated instances of the alternative spelling might be observed simply from rote memory. It was found that 7.6% of the children in the study were single letter users and spelled the endings of words consistently with omicron "ο". As can be seen from Table 5.4, 26.5% of the second graders were classified as single letter users. Only 3% of the third graders and 2% of the fourth graders spelled 15 out of the 16 words ending with /o/ sound with ο "omicron". No fifth grader was classified as a single letter user. The percentage of single letter users significantly decreased with age ($\chi^2_{(2)} = 39.45$, $p<.0001$).

For the final /e/ sound where there are two alternative spellings and one of them is a single letter and the other a digraph [ε "epsilon" and αι "alfa yiota"], the number of children who spelled the endings using only one alternative (ε) (by the same 15 out of 16 criterion) was greater (20%), probably because one spelling uses a single letter and the alternative is a digraph. As can be seen from Table 5.4, 55% of the second graders, 16% of the third graders, 10% of the fourth graders and 2% of the fifth graders were classified as single letter users. The percentage of single letter users significantly decreased with age ($\chi^2_{(3)} = 83.73$, $p<.0001$).

Table 5.4

Percentage of children who used only one spelling pattern by grade and ending sound

		Grade			
		Second	Third	Fourth	Fifth
Ending sound	/o/ sound	26.5%	3%	2%	-
	/e/ sound	55%	16%	10%	2%
	/i/ sound	16%	3%	3%	1%

The case of the final /i/ sound, which can be spelled in four different ways [ι "yiota", η "ita", οι "omikron yiota" and ει "epsilon yiota"] two of which are single letters and the other two are digraphs, was also considered. Here, the criterion used for a marked preference used was the use of a single spelling in 80% of the words, that is 26 out of the 32 words with the same letter (either ι or η). This criterion was used because there were four alternative spellings and not two as in the previous two examples. Either of the two spellings that use a single letter was counted as a preferred spelling because both of them are learned quite early and are used extensively in the first year of schooling. According to this criterion, 6% of the children in the study were still ignoring alternative spellings, although there were three other possibilities. As can be seen in Table 5.4, 15% of the second graders, 3% of the third graders, 3% of the fourth graders and 1% of the fifth graders were classified as single letter users for the /i/ sound. The percentage of single letter users significantly decreased with age ($\chi^2_{(3)} = 24.83$, $p<.0001$).

In conclusion, the analysis of the performance of those children that spelled the real words produced preliminary evidence that, where there are alternative spelling patterns for the same sound and at least one of them is the conventional spelling for a morpheme, some beginning spellers adopt one spelling pattern and ignore alternatives, thus failing in many cases to take account of morphology in their spelling. The evidence is stronger for the /e/ sound where more than half of the second graders who participated in the study used only one of the alternative spellings, probably because one of the alternatives was a digraph and the other a single letter. It has to be emphasised, however, that these children were in the second grade and they already had one year of instruction of reading and spelling. The percentage of single letter users might be bigger amongst first graders.

5.III.c. When children add the alternative spellings to their repertoire, do they assign the right spelling to the right grammatical categories?

It was hypothesised that when children add alternative spellings to their repertoire, they do not immediately assign the alternative spellings to the right grammatical categories. It was expected that children would start by using the newly adopted spelling pattern or patterns without making the necessary morphological connection. They apply the new pattern to inappropriate words as well as to appropriate ones. It was further hypothesised that it is after this intermediary stage, where children learn the alternative spellings but they do not understand the morphological basis for these different spellings, that children start to assign the spelling patterns to the right types of words. Each end sound will be examined separately to investigate replicability of the phenomenon.

The /o/ sound

For the /o/ sound the children (mean age = 7 years 4 months) who wrote exclusively or almost exclusively "o" for the /o/ endings were, as a group, correct 99.6% of the time they spelled "o" endings and 96% wrong when spelling the words ending in "ω". A second group of slightly older children (mean age = 8 years 1 month) was defined. The criteria for inclusion in this group were that a single spelling pattern should not be used more than 80% of the time and that the children should still be making many generalisation errors. These children, who started to adopt the "ω" spelling as well as the "o" significantly increased the probability of writing "ω" word endings correctly (53% correct spellings, a percentage that does not differ from chance level) but also decreased the probability of spelling "o" endings correctly: they were now correct in only 93% of the words ending in "o". Although this may appear a small difference, a t-test for the significance of the difference between independent means showed that the mean number of correct responses for the younger group was significantly higher than that of the older group (t=3.15;

d.f.=187; p<.005).

In order to examine whether young children start by using only one of the two alternatives for the spelling of the words ending with the /o/ sound, the percentage of second graders who spelled all the words with one letter and the percentage of second graders who used both spellings but made overgeneralisations was examined. A chi square test showed that the percentage of second graders that used both alternative spellings and made overgeneralisations was significantly higher than the percentage of second grade single letter users ($\chi^2_{(1)} = 8.78$, p<.005). This result is in accordance with a previous observation that for the /o/ sound an even younger group of children might be needed in order to be more confident that beginning spellers start by using a preferred letter for spelling the word endings.

This result gives some evidence, though not very strong, for the existence of an older group of children who overgeneralised the newly adopted spelling pattern to the incorrect category of words. A third group of even older children (mean age = 9 years 1 month) spelled both "o" and "ω" endings correctly. The criterion of spelling both categories of words systematically correctly (80% of the time or more) was used for inclusion in this group. Figure 5.2 presents the percentage of single letter users, the percentage of children who used both alternative spellings inappropriately and the percentage of children that used both alternative spellings appropriately for the /o/ sound. The percentage of children who used both alternative spellings but made a lot of generalisations significantly decreased with age ($\chi^2_{(3)} = 31.64$, p<.0001), although there was no significant difference between second and third graders. The percentage of children who spelled both categories correctly increased significantly with age ($\chi^2_{(3)} = 50.49$, p<.0001).

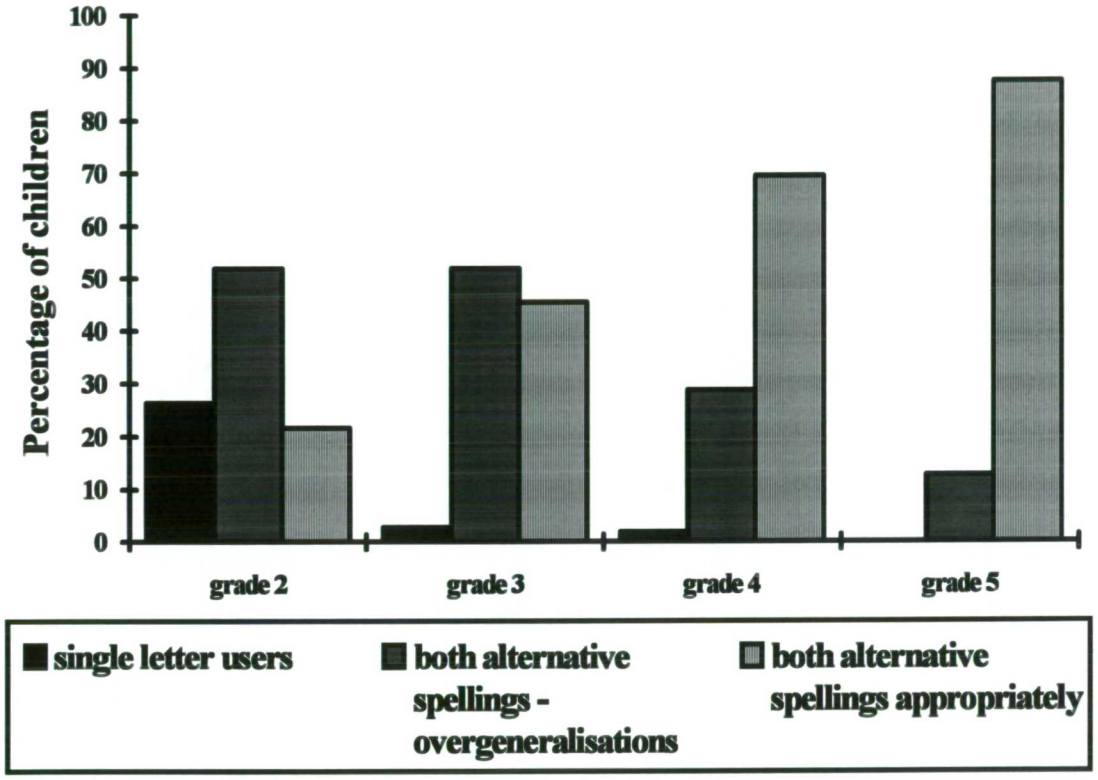


Figure 5.2
Percentage of single letter users, users of both alternative spellings inappropriately and users of both alternative spelling appropriately by age for the /o/ sound

The /e/ sound

The same analyses were carried out in order to see whether a similar trend would be observed with words that end in /e/. The criteria used for inclusion in each group were the same as in the /o/ sound. Younger children (mean age = 7 years 7 months) used the "ε" spelling for almost all of these word endings and were 99% correct in "ε" words and 97% wrong when the words ended in the digraph "αι". The intermediary group of children (mean age = 8 years 7 months), who use two spellings, spelled the words ending in "ε" correctly 83% of the time and those ending in the digraph "αι" 57% of the time. Their improvement is significant in the latter group of words (although it is not above chance level) but is also notable the fall in the percentage of correct spelling of "ε" words ($t=6.38$; $d.f.=318$; $p<.001$). This result is stronger evidence, than the result for the /o/ sound words, for the existence of a group of children that adopted the second alternative spelling pattern but overgeneralised it to inappropriate words.

The percentage of second graders who used a single letter in spelling the words ending with /e/ was significantly higher than the percentage of second graders that used both alternative spellings but overgeneralised the newly adopted spelling to inappropriate words ($\chi^2_{(1)} = 64.8$, $p<.0001$). This result shows that where there are alternative spellings for the same sound young children start spelling by using only one of the alternatives. Some possible reasons for the difference between this result and the result obtained for the /o/ sound will be discussed in the conclusions. As with the /o/ sound the percentage of single letter users for the /e/ sound might be even higher if younger children (first graders) were to be tested.

Again there is a third group of older children (mean age = 9 years 5 months) who spelled words with both endings systematically correctly. Figure 5.3 presents the percentage of children in each type of performance for the /e/ sound. Overall there

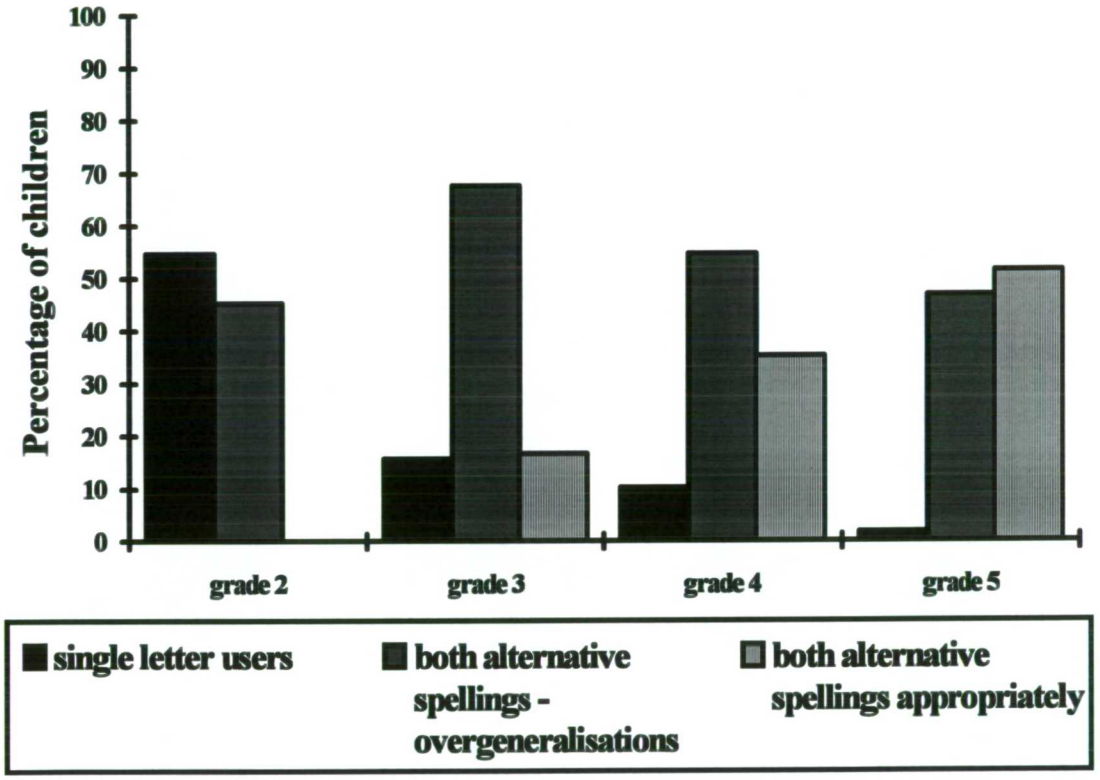


Figure 5.3
Percentage of single letter users, users of both alternative spellings inappropriately and users of both alternative spellings appropriately by age for the /e/ sound

were no significant differences between the percentages of children of the different grade levels that used both alternative spellings but made overgeneralisations ($\chi^2_{(3)}$ = 6.24, p=.10). However, the percentage of third graders making overgeneralisations was significantly higher than the percentage of second graders. This is because there is a high percentage (55%) of second graders that used only one of the alternatives in spelling the words ending with /e/. After the third grade the percentage of children who overgeneralised the newly adopted spelling pattern decreased with age. The percentage of children that spelled both the categories of words correctly significantly increased with age ($\chi^2_{(2)}$ = 20.19, p<.0001).

The /i/ sound

For the /i/ sound that can be spelled in four different ways this intermediary stage takes longer and has several levels. A group of younger children (mean age = 7 years 7 months) used only one way of spelling the ending of the words, one of the two single letters that represent the /i/ sound "ι" or "η" with a preference to the "ι". These children were approximately 93% correct in the words ending with their preferred letter and 91% wrong in the words ending in the other three letters.

A second group of children (mean age = 7 years 11 months) use two or more letters for spelling the /i/ sound but they use them in both appropriate and inappropriate word endings. The criteria used for inclusion in this group was that a single spelling pattern should not be used more than 80% of the time and that the children should still be making many generalisation errors. Children in this group still have a preferred letter for the /i/ sound ("ι" or "η") and they use this letter 50% of the time. They are approximately 70% correct in spelling these words but there is also an improvement in their performance (approximately 36% correct) of the other words. Their improvement is significant in the latter group of words but so is also the fall in the percentage of correct spelling of the words ending with their preferred letter (t=4.29; d.f.=159; p<.001). As in the /e/ sound the evidence for overgeneralisation

here is strong confirming the results obtained for the other two sounds; when children add new alternative spellings to their repertoire they use them both appropriately and inappropriately. The percentage of children who added alternative spellings to their repertoire, but made overgeneralisations decreased significantly with age ($\chi^2_{(3)} = 60.5$, $p<.0001$).

The percentage of second graders that used more than one of the alternative spelling patterns but made a lot of overgeneralisations was significantly higher than the percentage of second graders that used only one letter for the spelling of the ending of the words ending with /i/ ($\chi^2_{(1)} = 89.5$, $p<.0001$). This result is similar to the one observed for the /o/ sound. Although for the /i/ sound there are four alternative spelling patterns two of which are single letters which are commonly used in a number of Greek words as in the case of the /o/ sound. The percentage of single letter users might be higher if younger children (first graders) were to be added to the sample.

A third group of children (mean age = 8 years 8 months) use all the possible letters for the /i/ sound but only spell systematically correctly (80% of the time or more) two categories of words. The next group of children (mean age = 8 years 6 months) again use all the possible letters for the /i/ sound but get three of the four categories of words correct. Lastly, an older group of children (mean age = 9 years 5 months) spelled systematically correctly all the four groups of words. The percentage of children who spelled all the categories of words correctly significantly increased with age ($\chi^2_{(3)} = 88.9$, $p<.0001$). The percentage of children in each type of performance is presented in Figure 5.4.

In conclusion, when children adopt new alternative spelling patterns they do not at first, assign the new spellings only to the right type of words. They appear to go through an intermediary stage in which they use these patterns without

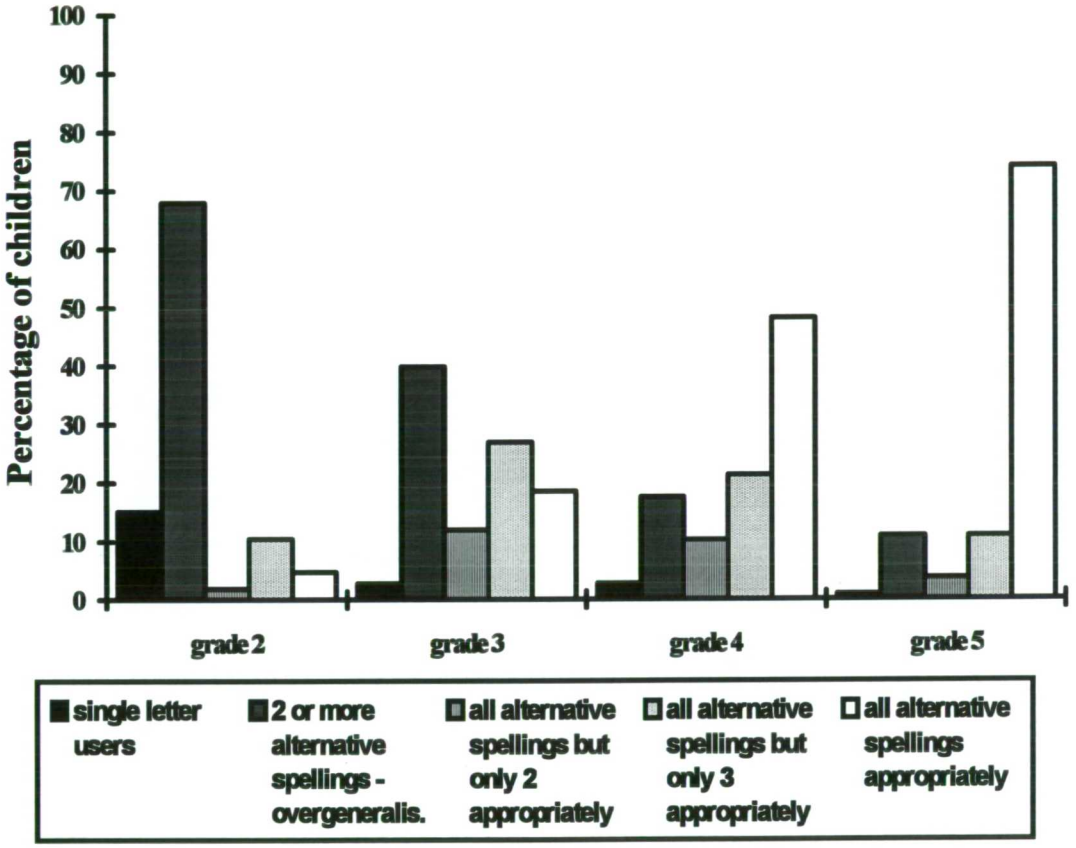


Figure 5.4
Percentage of children falling in each group of spellers by age for the /i/ sound

understanding their grammatical significance. They eventually restrict the new patterns to the right type of words.

5.III.d. Do children learn alternative spelling patterns by rote or do they make the syntactic and morphological distinctions involved in learning the use of the different spelling patterns?

It was hypothesised that children do not learn alternative spelling patterns by rote but they make the syntactic and morphological distinctions involved in learning the use of the different spelling patterns. It was predicted that the same developmental improvement as the one observed for the real words, would be found for the non-words.

The analyses that follow concentrate on the number of alternative spelling patterns that children used in spelling the ending sounds of non-words and whether they assigned these spelling patterns to the correct grammatical category. The analyses were carried out independently for each of the final sounds to study the replicability of the pattern across examples.

5.III.d.i. Do young children use one letter only in representing the final morpheme of pseudowords?

The first question that I proposed to answer was whether young children would spell pseudowords with one of the alternative spelling patterns as they do with real words. With respect to the final /o/ sound, where both alternatives are single letters and there are only two possibilities, "o" and "ω", the criterion used to identify single letter users was, as with the real words, the spelling of 15 out of the 16 non-words with the same letter. Approximately 24% of the second graders who spelled the non-words ending with /o/ were single letter users. As can be seen from Table 5.5 the

Table 5.5

Percentage of children who used only one spelling pattern by grade and ending sound

		Grade			
		Second	Third	Fourth	Fifth
Ending sound	/o/ sound	24%	6.5%	1%	2.5%
	/e/ sound	72%	24%	14%	9%
	/i/ sound	15%	2%	2.5%	2%

percentage of single letter users decreased with age ($\chi^2_{(3)}$ = 42.5, p<.0001). The percentage of single letter users found for the non-words ending with the /o/ sound (8.4%) is similar to that observed for the real words ending with the /o/ sound (7.6%) ($\chi^2_{(1)}$ = .23, p=.633).

For the final /e/ sound, the number of children who spelled the ending using one alternative (by the same 15 of 16 criterion) was even greater, probably because one spelling uses a single letter and the alternative is a digraph. As can be seen from Table 5.5, approximately 72% of the second graders who were given the non-words spelled the final /e/ sound with "ε" only. Although the percentage of single letter users significantly decreased with age ($\chi^2_{(3)}$ = 86.9, p<.0001), the percentage remains high even for older children. The percentage of single letter users found for the non-words ending with the /e/ sound (29.2%) is significantly higher than that observed for the real words (20.3%) ($\chi^2_{(1)}$ = 7.75, p<.01).

When the final /i/ sound, which can be spelled in four different ways, was considered again a group of single letter users was found. The criterion used for a marked preference was, as in the real words, the use of a single spelling in 80% of the non-words (at 26 out of 32). According to this criterion approximately 15% of the second graders in the study were still ignoring alternative spellings, although there were three other possibilities. There is no significant difference between the percentage of single letter users for words (5.3%) and non-words (5.2%) ($\chi^2_{(1)}$ = .0, p=1). As Table 5.5 shows, the percentage of single letter users was significantly decreased with age ($\chi^2_{(1)}$ = 24.48, p<.0001).

So the answer to the first question is simple. Young children tend to show a marked preference for one of the alternative spellings. This is true for both words and non-words and it was confirmed for all the three examples of ending sounds that were examined although the evidence for the /e/ sound was stronger probably because one

of the alternatives was a single letter while the other was a digraph which is used to mark the passive voice of a verb which is a complex grammatical concept. It might be that with a sample of even younger children (first graders) the percentage of single letter users would be even higher for all the three sounds.

5.III.d.ii. When children add the alternative spellings to their repertoire, do they assign the right spelling to the right grammatical categories?

The second question is concerned with the older children who are beginning to use the alternative spellings. Do they straightaway put these spellings at the ends of the grammatically appropriate words?

The /o/ sound

For the /o/ sound the group of children (mean age = 7 years 7 months) who wrote exclusively or almost exclusively "o" for the non-words ending with /o/ were, as a group, correct 99% of the time they spelled "o" ending words and 97% wrong when spelling the words ending in "ω". A second group of children (mean age = 8 years 4 months) who used both "ω" and "o" spellings significantly increased the probability of writing "ω" non-word endings correctly (58.4% correct spellings, a percentage that does not differ from chance level) but also decreased the probability of spelling correctly "o" endings: they were now correct only 90% of the non-words ending with "o". A t-test for the significance of the difference between independent means showed that the mean number of correct responses for the younger group was significantly higher than that for the older group ($t = 4.14$; d.f. = 239; $p<.001$). As with real words the percentage of second graders that used both alternatives but made overgeneralisations was significantly higher than the percentage of single letter users ($\chi^2_{(1)} = 12.81$, $p<.0005$). A sample of even younger children (first graders) is needed in order to examine whether young children start by using only one letter when there is more than one alternative for the spelling of the same sound.

Lastly, there is a third group of older children (mean age = 8 years 11 months) who spelled both "ο" and "ω" endings correctly. The percentage of children that fall into each of the three groups by age for each condition is presented in Figure 5.5. Overall the percentage of children that used both alternative spellings but made overgeneralisations did not significantly decrease with age ($\chi^2_{(3)}$ = 6.94, p=.074). However, the percentage of fifth graders that used both alternative spellings both appropriately and inappropriately was significantly lower than the percentage in the other three grades. The percentage of children that spelled both the categories of non-words correctly significantly increased with age ($\chi^2_{(3)}$ = 30.74, p<.0001).

The percentage of children who used both alternative spelling patterns but made overgeneralisations was higher for non-words than for real words ($\chi^2_{(1)}$ = 6.4, p<.05). Correspondingly, the percentage of children that spelled both categories correctly was higher for real words than for non-words ($\chi^2_{(1)}$ = 4.16, p<.05). These results show that the developmental pattern is similar for both words and non-words but there is a decrease in the percentage of older children that spelled the non-words using both alternative spellings systematically and an increase in their percentage of using both alternative spellings inappropriately.

<u>The /e/ sound</u>

For the non-words that end in /e/, a group of younger children (mean age = 7 years 9 months) used the "ε" spelling for almost all of these non-word endings and are 99% correct in "ε" non-words and 97% wrong when the non-words end in the digraph "αι". The intermediary group of children (mean age = 8 years 9 months), who use two spellings, spell the non-words ending in "ε" 85% of the time correctly and those ending in the digraph "αι" 53% of the time. Their improvement is significant in the latter group of non-words but also notable is the fall in the percentage of correct spellings of "ε" non-words (t = 7.5; d.f. = 104; p<.001). The percentage of second graders who used only one letter in spelling the endings of all the words was

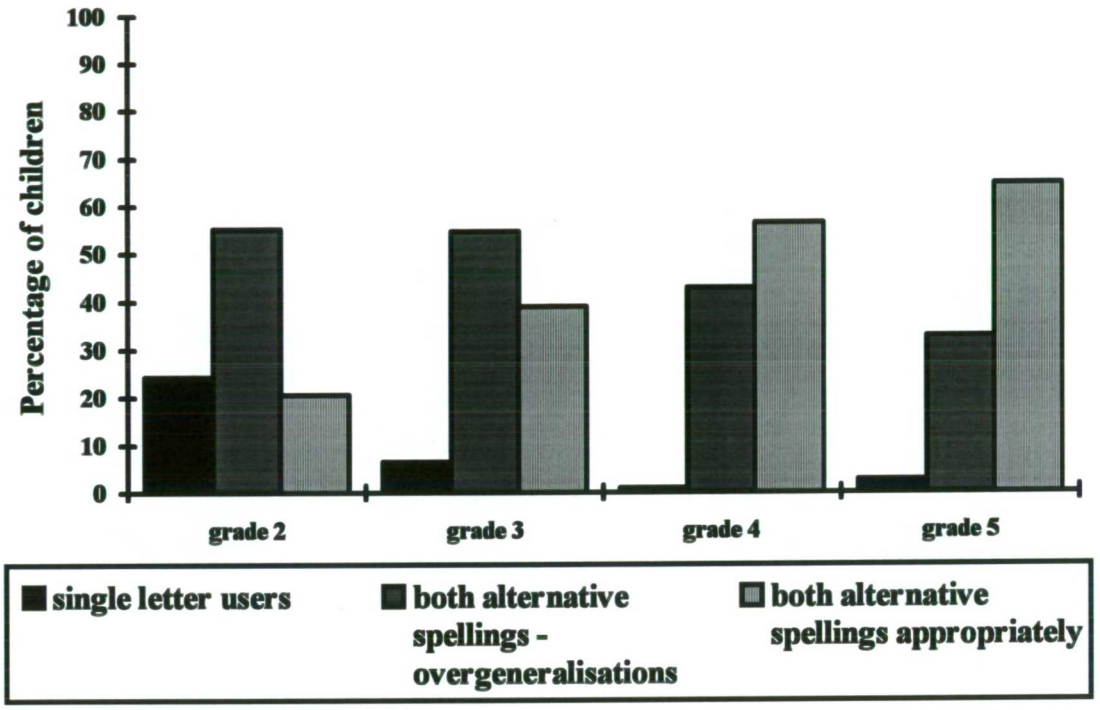


Figure 5.5
Percentage of single letter users, users of both alternative spellings inappropriately and users of both alternative spelling appropriately by age for the /o/ sound

significantly higher than the percentage of children who used both alternative spellings and made overgeneralisations ($\chi^2_{(1)} = 21.74$, $p<.0001$).

Again, there is a third group of older children (mean age = 9 years 5 months) who spell non-words using both alternative spellings systematically correctly. Figure 5.6 shows the percentage of children in each type of performance. The percentage of second graders that used the two alternative spellings both appropriately and inappropriately was significantly lower than the percentage of the other three age groups ($\chi^2_{(3)} = 22.36$, $p<.0005$). Although the percentage of children that used the two alternative spellings both appropriately and inappropriately decreased with age these differences were not significant from the third grade onwards. The percentage of children that spelled both categories of non-words correctly significantly increased with age ($\chi^2_{(3)} = 44.53$, $p<.0001$).

There was no significant difference between the percentage of children that used the two alternative spellings inappropriately in non words and in words ($\chi^2_{(1)} = .136$, $p=.713$) but the percentage of children that used the two spelling patterns appropriately is significantly higher in words than in non-words ($\chi^2_{(1)} = 8.6$, $p<.005$). The developmental path is similar for words and non-words, as was found for the /o/ sound.

The final /i/

Lastly, with respect to the final /i/ sound that can be spelled in four different ways development takes longer and several steps are observed.

A group of younger children (mean age = 7 years 8 months) use only one spelling for the ending of the non-words, one of the two single letters that represent the sound /i/, "ι" or "η". These children are approximately 96.5% correct in the non-words ending with their preferred letter, and 93% wrong in the non-words ending in

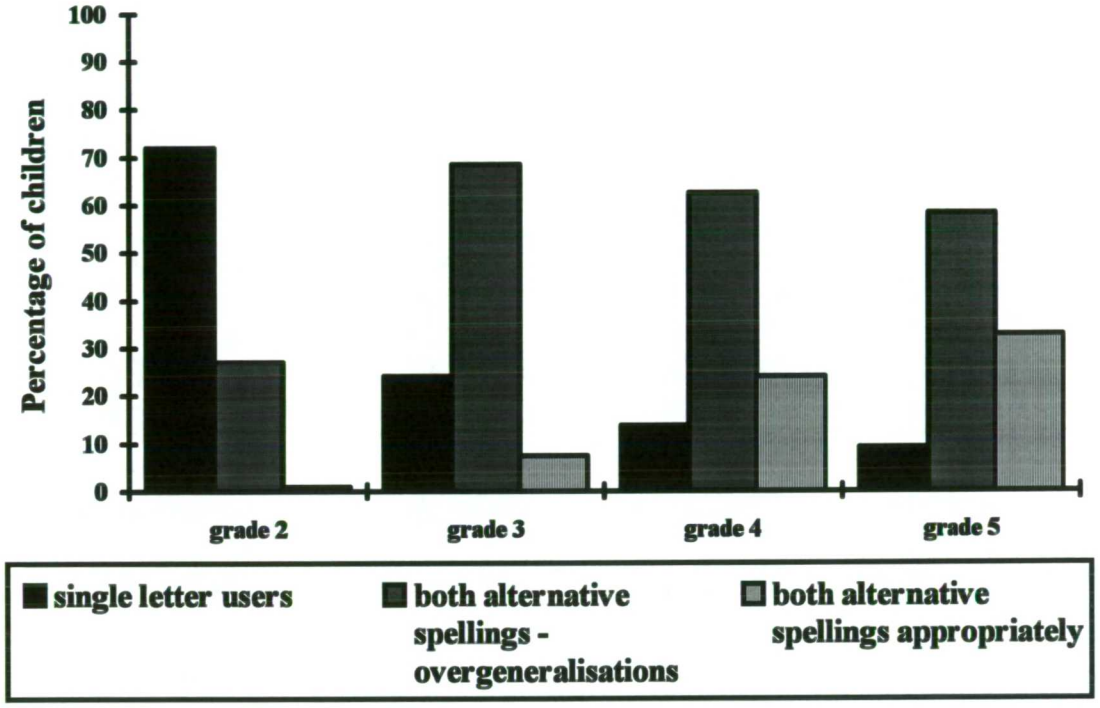


Figure 5.6
Percentage of single letter users, users of both alternative spellings inappropriately and users of both alternative spelling appropriately by age for the /e/ sound

the other three letters.

A second group of children (mean age = 8 years 3 months) used two or more letters for spelling the /i/ sound but they use them in both appropriate and inappropriate non-word endings. Children still have a preferred letter for the /i/ sound and they use it 46.5% of the time. They are approximately 75% correct in spelling these non-words but there is also an increase in their correct spelling of the non-words ending in the other sounds (36%). Their improvement in the latter group of non-words is significant but so is their fall in the former group of non-words ($t = 4.65$; d.f. = 236; $p<.001$).

A third group of children (mean age = 8 years 8 months) used three or more of the possible letters for the /i/ sound but only spelled systematically correctly two categories of non-words.

The next group of children (mean age = 9 years 1 month) used all the possible letters for the /i/ sound but only get correct three of the four categories of non-words.

Lastly, an older group of children (mean age = 9 years 4 months) spelled systematically correctly all the four categories of non-words. Figure 5.7 presents the percentage of children that fall into each group by age. The percentage of children that use more than one of the alternative spelling patterns but made overgeneralisations significantly decreased with age ($\chi^2_{(3)} = 18.88$, $p<.0005$). Conversely, the percentage of children that spelled all the word endings correctly significantly increased with age ($\chi^2_{(3)} = 16.67$, $p<.001$). The percentage of second graders who used only one of the alternative spellings was lower than the percentage of second graders who used more than one of the alternative spellings but made overgeneralisations ($\chi^2_{(1)} = 40.89$, $p<.0001$).

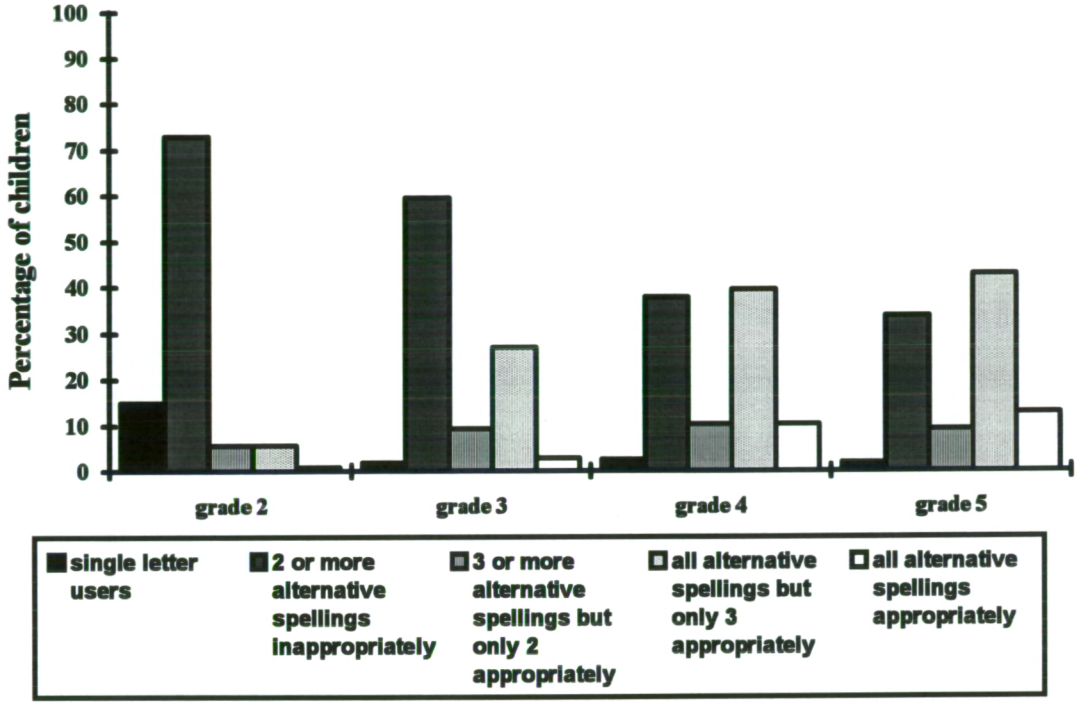


Figure 5.7
Percentage of children falling in each group of spellers by age for the /i/ sound

The percentage of children who made overgeneralisations was higher for non-words than for words ($\chi^2_{(1)}$ = 16.07, p<.0005). Consistently with this, the percentage of children that spelled all the endings correctly was higher for real words than for non-words ($\chi^2_{(1)}$ = 88.05, p<.0001).

The developmental pattern is similar for words and non-words but there are also significant differences in the frequency data for older children. The percentage of older children who spelled all the endings systematically correctly is higher for real words than for non-words. The percentage of children who spelled only three categories of words systematically correctly is higher in non-words than in words.

In conclusion, when there is more than one alternative spelling pattern for the same sound young children use only one of them. Older children, those who have two years of experience with reading and spelling add new spellings to their repertoire but they do not assign the newly adopted spellings only to the right type of words. They appear to go through an intermediary stage in which they use these patterns without understanding their grammatical significance. They eventually restrict the new patterns to the right type of words. This developmental path is replicated across end sounds and with words and non-words, supporting the hypothesis that children do not learn these spelling patterns by rote but they make the syntactic and morphological distinctions involved in learning the different spelling patterns. These results show that there is considerable development between the ages of 7 and 10 years in learning about the conventional spellings of the word endings.

5.III.e. Do children use information from the article in order to spell the ending of the words or non-words?

It was hypothesised that children can use information from the article that precedes the words in order to find the correct spelling pattern for the ending of the words.

Words are usually encountered in sentences. In Greek, nouns and adjectives are often preceded by an article which in many cases is the same or ends with the same letter or digraph as content word. There were four different conditions for the spelling task: (a) children spelled both the word and the article for the nouns and adjectives; (b) children spelled only the target word; the article was provided; (c) children spelled the non-word and the article when the non-word represented a noun or an adjective; and (d) children spelled only the non-word; the article was provided. If the hypothesis that children use information from the article in order to spell the ending of the word is correct then it is expected that the children that spelled the words or non-words for which the article was provided would perform better than the children that had to spell both the words or non-words and the article.

From the 64 words or non-words that the children had to spell 32 were verbs and consequently do not take an article. From the 32 nouns and adjectives that can be spelled with an article eight nouns were preceded by an article that did not have the same ending as the word or non-word. The ending of the article in these words represents a different sound from the ending of the words so there is no possibility of giving a negative clue for the spelling of the final morpheme in the words. Four adjectives were not preceded by an article. Thus there were three different groups of words and non-words: a) those preceded by an article (η, οι, το) which was the same or ended with the same letter as the ending of the word (20); b) those preceded by an article which did not provide a clue for the spelling of the ending of the word (8); in the same group were assigned the adjectives which were not preceded by an article (4); and c) words that are not spelled with an article (32). The Mean score and Standard deviation for each group of words by age and condition are presented in Table 5.6. The logarithmic transformations of the scores were used in the analysis that follows. Scores have been adjusted to the score of the verbs because the maximum score was different for each of the three groups of words.

Table 5.6

Mean words spelled correctly and standard deviations (in brackets) by word group, age and condition

Word group	Condition		Grade			
			Second	Third	Fourth	Fifth
Nouns / adjectives preceded by an article*	words	article not provided	17 (4.39)	23.85 (5.97)	27.93 (4.9)	29.44 (3.93)
		article provided	20.25 (6.38)	27.37 (4.88)	28.47 (5.3)	30.4 (3.91)
	non-words	article not provided	17.18 (4.08)	23.45 (5.41)	25.3 (5.49)	25.4 (4.83)
		article provided	20.21 (5.41)	24.39 (5.21)	26.87 (5.02)	27 (5.57)
Nouns / adjectives preceded by an article (without clue for the spelling)*	words	article not provided	19.87 (6.32)	22.94 (6.94)	28.07 (5.15)	29.57 (5.19
		article provided	21.19 (8.83)	26.37 (5.84)	28.02 (4.98)	30.19 (4.01)
	non-words	article not provided	19.42 (6.33)	22.16 (6.92)	24 (5.51)	23.56 (5.8)
		article provided	21.58 (5.89)	19.17 (7.17)	24.4 (6.18)	24.97 (4.98)
Verbs	words	article not provided	12.49 (4.38)	19.83 (5.33)	25.69 (5.73)	28.05 (4.48)
		article provided	16.27 (6.1)	24.36 (5.3)	25.62 (5.85)	29.05 (4.06)
	non-words	article not provided	14.11 (5.43)	21.95 (6.32)	23.33 (6.28)	24.76 (5.66)
		article provided	15.63 (5.37)	19.36 (4.57)	24.42 (5.26)	25.35 (6.19)

* adjusted scores

Maximum score = 32

The number of correct spellings was subjected to a mixed model Analysis of Variance, in which age (4: 7 year-olds, 8 year-olds, 9 year-olds and 10 year olds), word-type (2: words, non-words) and the condition (2: article provided, article not provided) were the between subjects factors, and the word group (3: nouns - adjectives that had to be spelled with an article, nouns - adjectives that had to be spelled without an article and verbs) was the within subjects factor.

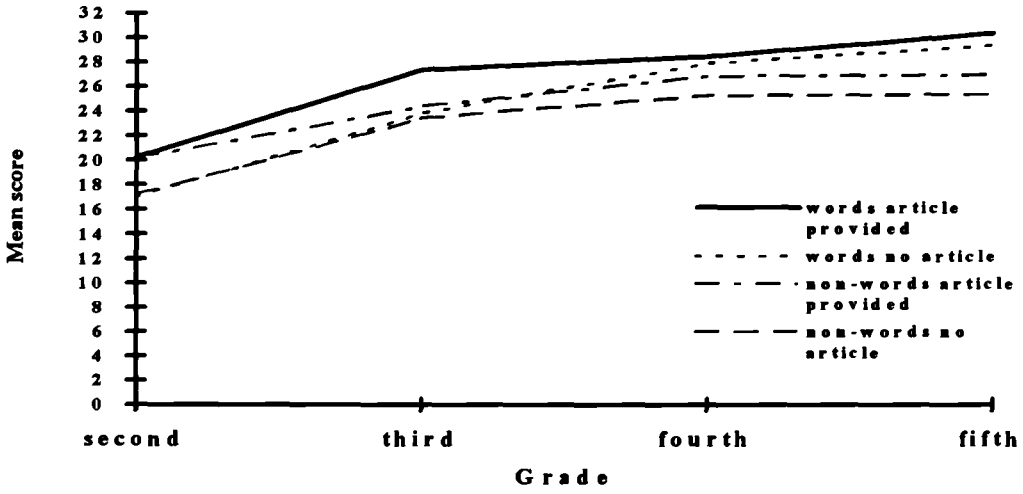
The main term of age was significant ($F(3,857)=168.65$, $p<.001$). Post-hoc (Newman Keuls) tests showed that all the comparisons were significant ($p<.001$). Children performed significantly better on words than on non-words ($F(1,857)=33.04$, $p<.001$). The interaction between age and word-type was significant ($F(3,857)=7.38$, $p<.001$). Post-hoc comparisons showed that third, fourth and fifth graders performed significantly better in words than in non-words ($p<.005$). There was no significant difference between words and non-words for the first graders ($p=.736$). Children performed significantly better in the condition where the article was provided than in the condition where the article was not provided ($F(1,857)=13.64$, $p<.001$). Neither the interaction between condition and age nor the interaction between word-type and condition were significant ($F(3,857)=2.10$, $p=.099$ and $F(1,857)=3.14$, $p=.077$ respectively). The three way interaction age by word-type by condition was significant ($F(3.857)=5.18$, $p<.005$).

The group of words factor was significant ($F(2,1714)=109.65$, $p<.001$). Post hoc (Newman-Keuls) comparisons showed that children performed significantly better in the nouns and adjectives which were preceded by an article than in the other two groups ($p<.05$) and significantly better in nouns and adjectives which were preceded by an article which did not give a clue for the spelling of the word than in the verbs ($p<.05$). The group of words by age interaction was significant ($F(6,1714)=29.87$, $p<.001$). The group of words by word-type and the group of words by condition interactions were significant ($F(2,1714)=7.20$, $p<.005$ and $F(2,1714)=5.52$, $p<.001$

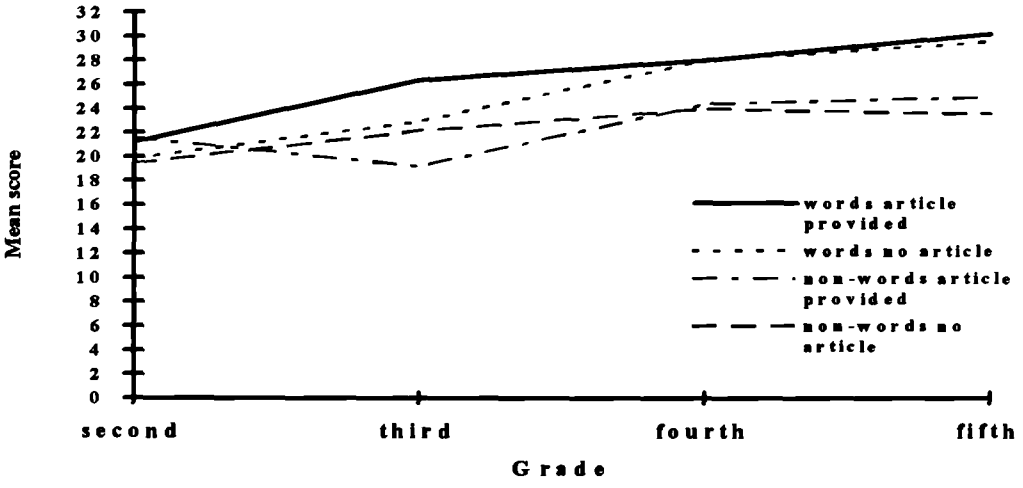
respectively). None of the three way interactions (age by word-type by group of words, age by condition by group of words and word-type by condition by group of words) was significant. The four way interaction age by word-type by condition by group of words was significant ($F(6,1714)=2.43$, $p<.05$). This interaction is presented in Figure 5.8.

When this interaction was analysed using post hoc tests it was shown that for fifth graders words were easier than non-words in all the three groups of words independently of condition. For the fourth graders words were easier than non-words independently of condition for the nouns and adjectives but not for the verbs where no significant differences were found. The presence of the article had no significant effect on these children's performance. Third graders, in the nouns/adjectives preceded by an article, performed better in the condition where the article was provided in the real words than in words where the article was not provided and non-words independently of whether the article was provided. In the nouns/adjectives which were preceded by an article which did not give any clue of the spelling, third graders performed significantly worse in the non-words article provided condition than in the other three conditions and significantly better in the words article provided condition than in the words article not provided condition. In verbs, third graders performed significantly better in the words article provided condition than in the other three conditions. Lastly, second graders in the nouns/adjectives that were preceded by an article performed significantly better in words and non-words for which the article was provided than in words or non-words for which the article was not provided. There were no significant differences for the nouns/adjectives which are preceded by an article which did not provide any clue for spelling. For verbs, second graders performed significantly better in words or non-words for which the article was provided than in words for which the article was not provided.

Nouns/adjectives spelled with article



Nouns/adjectives spelled without article



Verbs

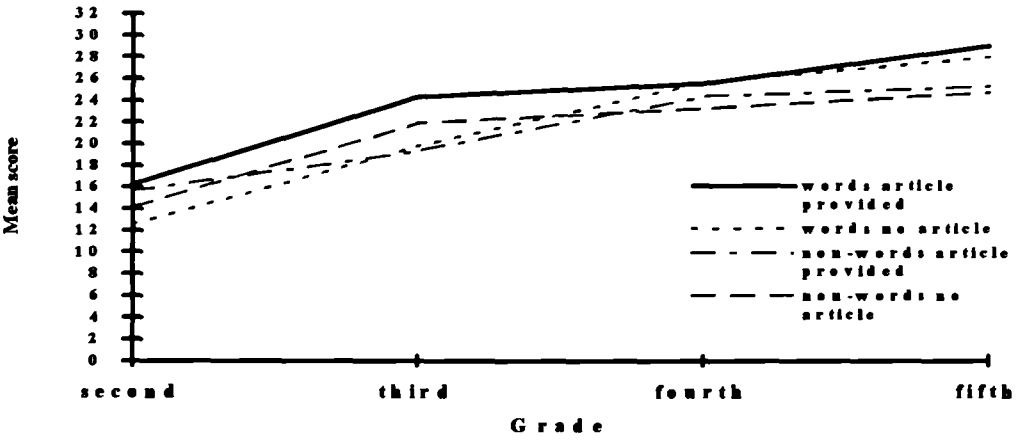


Figure 5.8
Mean score of words spelled correctly by age, word-type and condition

In summary, the older children performed better than the younger ones. Older children (fourth and fifth graders) performed significantly better in words than in non-words showing that as children get older they rely on both their grammatical awareness and rote learning. Lastly, the presence of the article improved only younger children's performance. However, this conclusion is not strongly supported by the data because significant differences between the conditions were found for verbs or for nouns and adjectives which were preceded by an article which did not give any clue for spelling. It might be that children in some conditions performed better than children in other conditions because they were better spellers and the presence of the article had no effect on their performance.

5.IV. Discussion and Conclusions

5.IV.a. Summary of the results

1. There is a sharp increase with age in schoolchildren's success in writing the ending sound of nouns, adjectives and verbs.

2. When there are alternative spelling patterns for the same sound which are the conventional spellings for different morphemes, young children start by using consistently only one of these alternative spellings, irrespective of which morpheme is being spelled.

3. When children add new spelling patterns to their repertoire, they do not at first understand their grammatical significance. They use these newly adopted spelling patterns both appropriately and inappropriately. Children make a number of generalisations by using the endings of neuter nouns, for example, when spelling feminine nouns or adjectives.

4. The developmental sequence (using one letter only for the spelling of all the endings; using more than one spelling pattern inappropriately; restrict the use of each spelling pattern to the right type of words) was found for both words and non-words. The performance of the group of children who spelled the real words was superior to the performance of children who spelled the non-words but this developmental sequence showed a similar pattern in both words and non-words.

5. The presence of the article has no effect on older children's performance. For younger children the article had an effect on their performance but this conclusion is not strongly supported by the data since the children assigned to this condition performed better than the children in the condition where the article is not provided even in words that were not spelled with an article, such as verbs.

In the next section, these results are discussed in more detail in relation to each of the hypotheses of the study.

5.IV.b. Discussion of the results

Hypothesis 1: Where there are alternative spellings for the same sound, children at first tend to show a marked preference for one of the alternative spellings.

The hypothesis was supported by the data. For all the ending sounds that have been examined, for which there are two or more alternative spellings and the grammatical status of each word involved decides which spelling sequence it should contain, there was a group of younger children who preferred only one of the alternative spellings. When one of the alternative spellings was a digraph the percentage of users of only one of the alternative spellings was even bigger. Even when there were four alternative spellings there was a percentage of beginning spellers that used only one of the four alternatives.

The difference between the words ending with /o/ and the words ending with /e/ might be explained by two facts: a) for the /o/ sound both alternatives are single letters while for the latter one of the alternatives is a single letter and the other is a digraph; and b) for the /o/ sound the two alternative spellings are used in two classes of words that are quite distinct (nouns and verbs) while in the /e/ sound both alternatives are used in verbs, one of them (the single letter) denoting the active voice and the second (the digraph) the passive voice, a discrimination much more difficult than the one between nouns and verbs.

This result is consistent with Nunes et al.'s (1997) finding that English children start spelling the final morpheme of regular past verbs phonetically avoiding the correct "ed" ending for these words. This result is also consistent with Bryant et al.'s (1997) finding that English children do not use the apostrophe even after four years of experience with reading and spelling, and with Totereau et al.'s (1997) finding that French children in the first years of schooling spell the plural nouns and verbs by representing the sounds of the words and without using the conventional "s" and "nt" spellings.

In the present study the results of previous researchers are extended by showing that even when the spelling of the ending morpheme does not depart from a representation of phonology but there are still alternative phonologically acceptable spelling patterns, children initially tend to ignore the grammatical basis of these spellings. The present study also provides evidence that children's ignorance of the connections between morphology and spelling is not particular to only one language but is a phenomenon common to many different languages with alphabetic scripts.

Hypothesis 2: When children add alternative spellings to their repertoire, they do not assign the alternative spelling to the right grammatical categories but they apply them to inappropriate words as well as to appropriate ones.

The hypothesis was supported by the data. Apart from the group of children that spelled all the endings of all the words with the same letter, there was a group of older children that used all the alternative spellings but they used these added spelling patterns both appropriately and inappropriately. These children, after one year or more of experience with reading and writing learn that there are alternative spellings for the endings of the words but they do not yet understand the connection between morphology and spelling.

The generalisations that children make result in a significant improvement in their correct spelling of the words which are spelled with their non-preferred spelling pattern but also in a significant decrease in their correct spelling of the words that are spelled with their preferred spelling. This intermediate stage of children's development of morphological spelling is quite lengthy. It is only at the fourth and more completely at the fifth year of schooling that children start to understand the morphological basis for these different spellings. When there are more than two alternative spelling patterns for the same sound this intermediary stage is longer. It is only a third group of even older children who spelled the endings of all the words correctly.

These results are consistent with Nunes et al. (1997) finding that when English children start to use the 'ed' morpheme for the regular past verbs, they use it both for regular and irregular verbs and for non-verbs. They also found that older children restrict the "ed" ending only to verbs, both regular and irregular, and finally they only use it in the regular past verbs. The results are also consistent with Bryant et al. (1997) finding that when English children start using the apostrophe they use it

without understanding its grammatical basis (this understudying comes later), and with Totereau et al (1997) who found that when French children start to use the 's' spelling for plural nouns they also use it for plural verbs incorrectly although they seem to have a partial understanding of the connection between the "s" spelling pattern and plural because they do not use it for singular nouns.

Hypothesis 3: Children do not learn alternative spelling patterns simply by rote; they also make the syntactic and morphological distinctions involved in learning the use of the different spelling patterns.

On all three ending sounds children who spelled the real words and children who spelled the non-words showed the same developmental sequence. This result supports the hypothesis that children's use of morphological spelling strategies follows a developmental progression. Children who spelled the non-words had no other way of spelling them right but to make the syntactic and morphological distinctions involved in learning the use of the different spelling patterns.

This result does not rule out the possibility that children learn some word endings by rote. The performance of the children who had been given the real words was superior to the performance of children who had been given the non-words. However, the two groups differed only in the percentage of children that fall in the intermediary and in the final stages of development (more children from the real words group spelled correctly all the word endings and more children from the non-words group used all the alternative spelling patterns both appropriately and inappropriately) showing that children use both their previous experience with spelling and their grammatical awareness.

The results of the present study also confirmed the previous observation that there is a considerable development between the ages of 7 to 10 years in learning the

conventional spellings of the conventional final morpheme in verbs, nouns and adjectives.

These findings are consistent with Nunes et al.'s (1997) finding that English children's learning of the "ed" morpheme for the regular past verbs which is a grammatically based spelling pattern is influenced by the children's knowledge of grammatical distinctions. In their study they used pseudoverbs and they found that both children's grammatical awareness and their phonological awareness made independent contributions to their growing understanding of the "ed" spelling.

Hypothesis 4 : Children use information from the article in order to spell the ending of words or non-words.

The hypothesis was not confirmed by the data. There was no effect of the presence of the article on the performance of older children. The significant effect that was found on younger children's performance is not strong evidence because it was not confined to the words that were preceded by an article but also found for verbs, nouns and adjectives that were no preceded by an article. It might be that the group of young children assigned to this condition performed better than the children assigned to the condition where the article was not provided. In conclusion, the presence of the article has no effect on children's spelling of the ending of the words which depend on morphology.

5.IV.a. Conclusions and limitations

Study 4 has shown that Greek children start spelling by using a simple phonological strategy before they adopt a more complex morphological strategy. In studies 1, 2 and 3 it was also found that in Greek, reading develops from simple phonological rules to more complex ones, such as conditional rules.

In this study, it has been demonstrated that there is considerable development between the ages of 7 to 10 years in the use of morphological spelling strategies. The acquisition of morphological strategies by children is not accomplished in a single step but develops over at least 3 years from the time that children start to learn to read and write. Children concentrate initially on mastering phonological aspects of spelling and only after they have conquered these to a reasonable extent do they incorporate morphological strategies into their repertoire. When children start to use morphemes as spelling units, they do not seem, at first, to understand their function but later come to understand when to use morphemes as spelling units.

A limitation of the present study is that it provides only cross-sectional data examining children's spelling only on one occasion. Longitudinal data would be needed to find out whether individual children progress through the stages of the development of morphological spelling and even younger children (first graders) would be needed in order to confirm the observation that young children start by using only one letter in spelling the ending sound of nouns, adjectives and verbs. More instances of spelling patterns which depend on morphology should be investigated in order to see whether the model accounts for the development of children's morphological spelling in general and not just the specific instances of the final morpheme of the some nouns, adjectives or verbs. The role of phonological awareness in the development of spelling also needs to be examined in relation to morphological awareness. Lastly, the present study has shown that there is a pattern in the development of morphological spelling strategies without showing whether there is a basis for this development. It might be that children's use of morphological spelling strategies is based on their morphological awareness. This hypothesis is examined in the next study.

CHAPTER 6: STUDY 5
IS THERE A BASIS FOR LEARNING MORPHOLOGICAL SPELLINGS?

6.I. Introduction

In the previous chapter it was found that there is a pattern in the development of morphological spelling strategies. In this chapter the processes involved in the acquisition of morphological spellings are examined. It is proposed that morphological spelling strategies are necessary for spelling in Greek and that their acquisition is based on children's awareness of grammar.

In recent years some studies have shown how important it is for children to understand the connection between grammar and spelling (Nunes et al., 1997a, b, and c; Bryant et al., 1997a, and b; Totereau et al., 1997). These studies also revealed that this acquisition is not simple and happens over an extended period of time. Nunes et al. (1997), for example, showed that children's progression from a phonetic to a morphological strategy in spelling the past tense morpheme in English is linked to their developing grammatical awareness.

The question that this chapter examines is related to the processes in the development of spelling: is there a basis for learning the conventional spellings of morphemes when children use these spellings appropriately? If children cannot learn the spelling of the final morphemes on the basis of phonology how they can learn it? The hypothesis is that children ground their understanding of when to use the newly adopted spelling patterns on their developing awareness of grammar. If this hypothesis is correct there should be correlations between the spelling patterns examined and children's grammatical awareness. It has to be mentioned that the present study is cross-sectional and the results have to be interpreted with caution about the possible predictions. This study can be only a first step in looking at causal

connections between grammatical awareness and spelling and longitudinal studies are needed in order to analyse the direction of the relation.

6.II. Method

6.II.a. Participants

The 214 children who had been asked to spell the words and the article (first condition) in the previous study, participated in this study, divided into four age groups: 51 children 7 years old (mean 7;1 range 6;7-7.6), 53 children 8 years old (mean 8;1 range 7;8-8;7), 55 children 9 years old (mean 9;1 range 8;8-9;6) and 55 children 10 years old (mean 10;1 range 9;9-10;7). The four groups were in grades two, three, four and five respectively. The children were sampled from four different public schools in the city of Katerini in North Greece. The intake of these schools varied considerably in socio-economic terms and as a result the sample covered a wide range of socio-economic backgrounds. All the children who participated in the study had learned Greek as their first language.

6.II.b. Materials and procedure

In addition to completing the spelling task described in the previous chapter, the children answered three tasks designed to measure awareness of grammar, adapted from the same paradigm developed by Nunes et al. (1997): a word analogy test, a sentence analogy test and a productive morphology test. The decision to ask children to spell both the word and the article was made in order to avoid any effect from the presence of the article on children's spelling although this effect was not strongly supported by the results of the previous study. The three morphological awareness tasks were designed to measure whether children were aware of the distinctions

between different parts of speech e.g. verbs, adjectives, singular and plural, passive and active voice, and different persons of verbs. All three tasks were entirely oral: they involved no written material. The three morphological awareness tasks were given to children in the second session.

Two of the tasks involved explicit awareness of grammar. The third task involved implicit awareness of grammar. The two first tasks were based on the analogy paradigm, where the children must identify a relationship between one pair of stimuli and apply the same relationship to complete the second pair, following the model a:b::c:d (Piaget, Montangero and Billeter, 1977; Sternberg, 1977). In the third task children had to transform non-words by adding the appropriate morpheme based on Berko's well known pseudoword task (Berko 1958). These tasks were used in order to ascertain whether the children were aware of the distinctions between different categories of words and whether they could manipulate inflectional and derivational morphemes.

Sentence analogies There were fourteen trials, and the tasks were presented with the support of two puppets. In each trial the first puppet "said" a sentence and then the second puppet "repeated" it but with a change to the tense of the verb (e.g. "Tom helps Mary" and "Tom helped Mary"). Then the first puppet "said" a second, quite similar, sentence (e.g. "George phones Tony"); the child was asked to play the role of the second puppet and to make the same change to this sentence as the puppet had to make to the first. The changes, which were made to one verb and which the child had to make to the other, were from present to past tense and vice versa, from present to future and vice versa and from active to passive voice and vice versa. By using this task it could be demonstrated whether the child could make the same change in the tenses as the experimenter had. Examples are given in Table 6.1.

Word analogies There was another analogy task, but this time the analogies were

Table 6.1

Sample questions from the three morphosyntactic tasks

The Sentence Analogy Task

1. Ο Γιώργος βοηθά την Ελένη.	Η Μαρία πίνει το γάλα της.	
Ο Γιώργος βόηθησε την Ελένη.	-	
George helps Helen.	Maria drinks her milk.	
George helped Helen.	-	
2. Ο Νίκος παίζει μπάλα.	Η γιαγιά ράβει μια μπλούζα.	
Ο Νίκος θα παίξει μπάλα.	-	
Nikos plays football.	The grandmother stitches a blouse.	
Nikos will play football.	-	

The Word Analogy Task

1. όμορφη	ομορφιά	νόστιμη	-
beautiful (she)	beauty	tasty (she)	-
2. λύνω	έλυσα	βάφω	-
untie	untied	paint	-

The Productive Morphology Task

1. Αυτή είναι μία λοκία. Τώρα υπάρχει ακόμα μία λοκία. Κοίτα υπάρχουν δύο. Είναι δύο _____. (λοκίες)
This is a lokia. Now there is another lokia. Look there two of them. There are two *lokies*.

2. Αυτή είναι μια κυρία που ξέρει να πακεύει. Τώρα κάνει το ίδιο μαζί με ένα φίλο της. Τι κάνουν τώρα και οι δύο; Και οι δύο _____. (πακεύουν)
This a lady who knows how to pakevi. Now she is doing the same thing with her friend. What are they both doing? They *pakevoun*.

between words (λύνω-έλυσα tie-tied, βάφω-έβαψα paint-painted). Otherwise the task was exactly like the sentence analogy task except that there were sixteen trials including transformations from present tense to past tense, from active voice to passive voice, from adjective to noun, from verb to noun, from verb to adjective, from first person singular to second person plural, and from adverb to verb. The range of grammatical transformations used in this task was even greater. Examples are given in Table 6.1.

Productive morphology task An adaptation of Berko's (1958) task was used. The children were given pictures and in describing these pictures pseudo-words were used: then children were asked questions which required them to transform these pseudowords by adding a morpheme (e.g. This is a lokia. Now there is another lokia. Look there are two of them. There are two lokies). Four trials dealt with singular to plural transformations. In three trials, transformation involved present and past tenses and in another three present and future tenses. Three trials dealt with third singular person to third plural person transformations. The last six trials involved possessive and derived agentives. Examples are given in Table 6.1.

The three grammatical awareness tasks are Fully presented in Appendix 5.

Standardised test.

Children were also given two verbal sub-tests (vocabulary and lexical analogies) of the Athina test which is a test for measuring children's general abilities (Paraskevopoulos et al., 1996). It was used as a control measure of verbal ability in statistical analyses.

The vocabulary subtest consists of 35 words, arranged in ascending order of difficulty. The child is asked to explain what each word means, with the question

"what is a ....." or "what does ..... mean". Each response is scored 0, 1 or 2, according to the degree of understanding of the word shown by the child's response.

The lexical analogies subtest consists of 24 questions. For each question there are two sentences with the last word of the second sentence missing. The child has to supply the missing word of the second sentence which is analogous to the first one (e.g. animals have legs, cars have .....(wheels). These analogies were not morphological.

6.III. Results

The results are presented in two sections. In the first section univariate statistics for each task that the children carried out are described. In the second section children's understanding of the grammatical basis for the conventional spelling of morphemes when they use these spellings appropriately is examined by analysing the relations between the spelling patterns and children's grammatical awareness.

6.III.a. Descriptive statistics.

6.III.a.i. Spelling task

One point was given for each correct spelling of the ending of the words (maximum possible score 64). The mean score was 46.6 and the Standard Deviation 13.62. Because there was a linear relationship between these two statistics ($r=-.88$) a logarithmic transformation of the data was performed. Frequency distribution of the transformed data is presented in Figure 6.1. A One-Way Analysis of Variance showed significant differences between the four age groups ($3,210)=98.15$, $p<.0001$). Post hoc (Newman-Keuls) tests showed that all the comparisons were

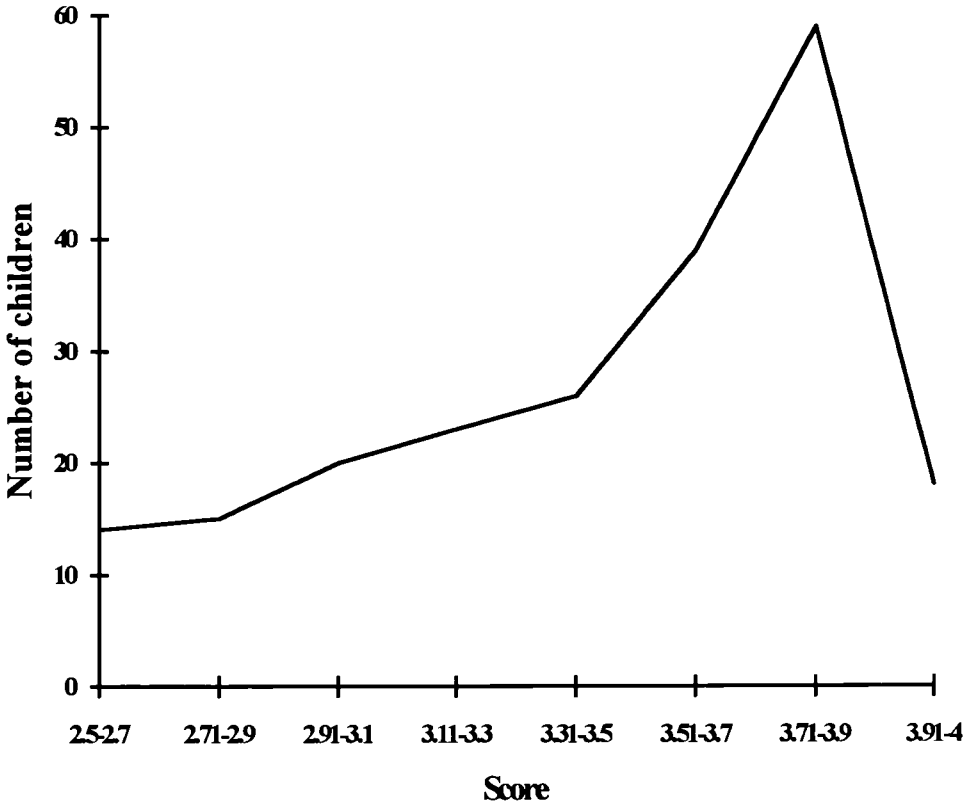


Figure 6.1

Frequency Distribution of scores in the spelling task

significant.

6.III.a.ii. The three grammatical awareness tasks

One point was given for each correct answer in these tasks.

Sentence analogies Figure 6.2 shows the frequency distribution of the transformed into logarithms (with 10 base) scores in the task. The maximum possible score of the original data was 14 and the mean score was 8.9 (SD 4.44). The majority of scores lay at the higher end of the distribution. Nine and ten year old children performed quite well in the task. The mean scores ascended by Grade but no age group performed at ceiling level. A One-Way Analysis of Variance showed significant differences between the four age groups ($F(3,210)=72.18$, $p<.0001$). Post hoc (Newman-Keuls) tests showed that each older age group performed significantly better than the younger ones.

Word analogies The frequency distribution of the transformed into logarithms scores in this task is presented in Figure 6.3. The maximum possible score of the original data was 16, and the mean score was 10.75 (SD 3.74). The distribution was skewed towards the higher scores. When the mean of the four age groups were compared, it was found that each older age group performed significantly better than the younger ones ($F(3,210)=105.3$, $p<.0001$).

Productive morphology The maximum possible score in the task was 21 and the mean score was 14.56 (SD 3.75). The frequency distribution of scores is presented in Figure 6.4. The distribution of scores was approximately normal. Significant differences between the performance of the four age groups were found ($F(3,210)=35.25$, $p<.0001$). Post-hoc (Newman-Keuls) tests showed that all the comparisons were significant and each older age group performed better than the

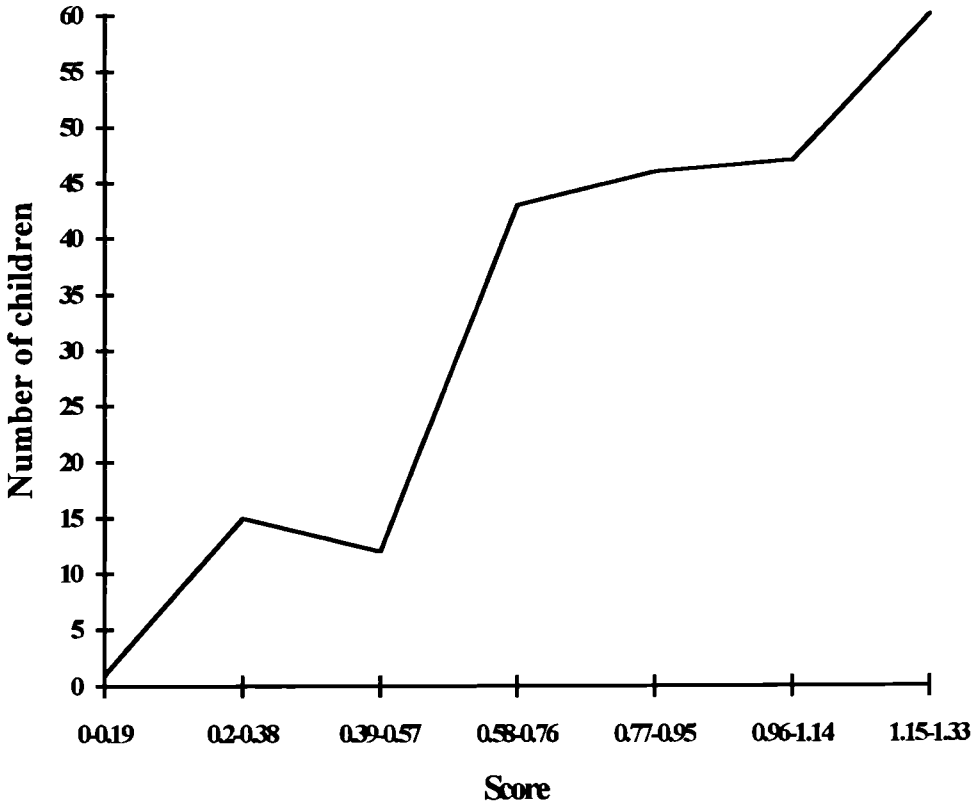


Figure 6.2

Frequency Distribution of scores in the sentence analogy task

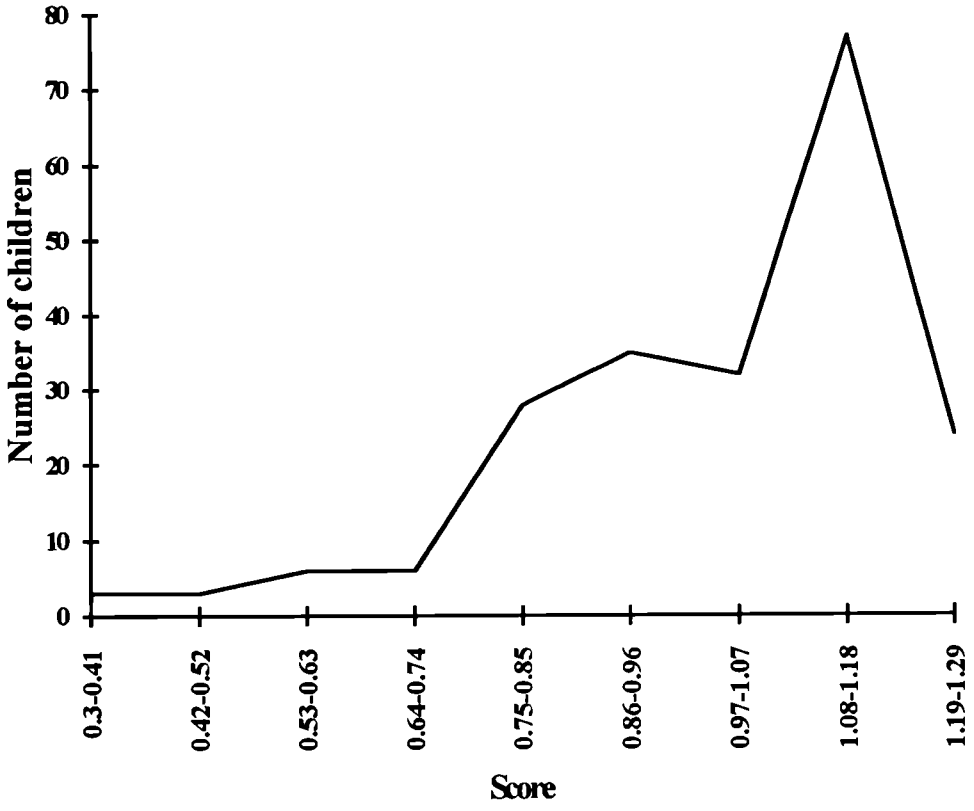


Figure 6.3

Frequency Distribution of scores in the word analogy task

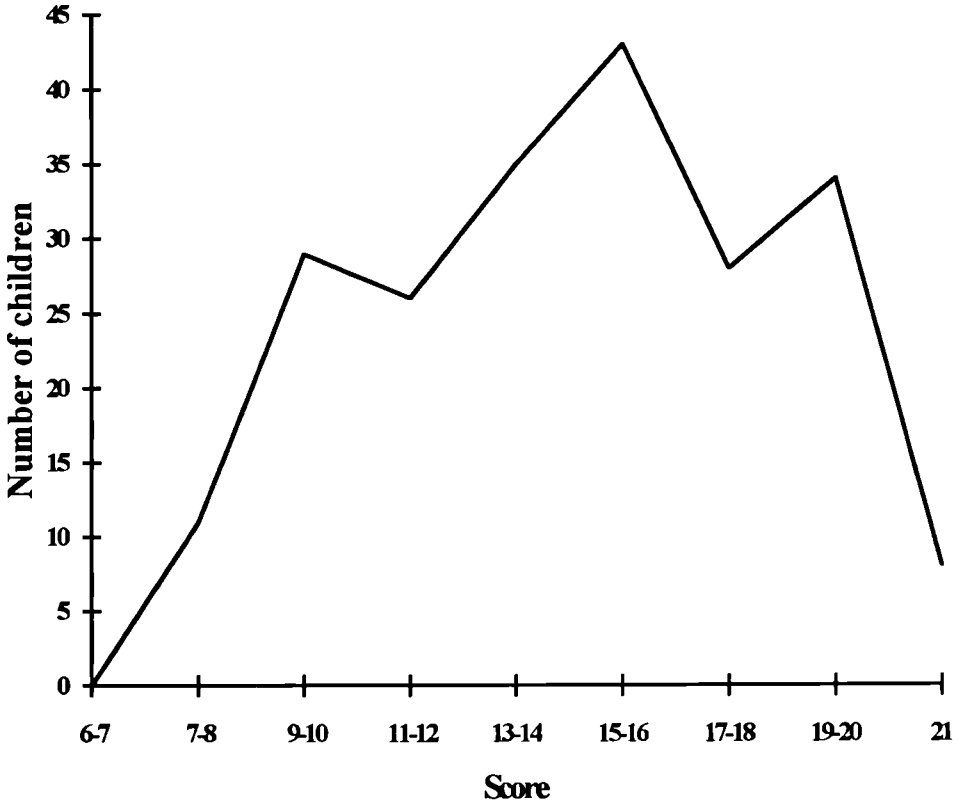


Figure 6.4

Frequency Distribution of scores in the productive morphology task

younger ones.

6.III.a.iii. The Verbal ability test

Raw scores ranged from 28 to 87. The maximum possible score was 94 and the mean 61.74 (SD 14.24; N=214). Frequency distribution of scores is presented in Figure 6.5.

6.III.b. Is there a basis for learning the conventional spellings of morphemes when these are used appropriately by children?

At the core of this question is the investigation of processes in the development of spelling. The hypothesis is that children ground their understanding of when to use these new spelling patterns on their developing awareness of grammar (the term "grammar" here is used in a broad sense, to include both syntax and morphology, because morphology is not independent of syntax). If this hypothesis is correct there should be correlations between these spelling patterns and children's grammatical awareness.

Table 6.2 gives the correlation coefficients between the total scores in the different spelling patterns and the grammatical awareness tasks. As can be seen from Table 6.2 the correlations between the different spelling patterns and the grammatical awareness tasks were quite high. These strong relationships between the three different spelling patterns which depend on morphology, show that the children in the study were using a morphologically based spelling strategy.

The set of analyses that follows was concerned with the relations between children's spelling of the endings of the words and their grammatical awareness. Because children's scores in the three spelling patterns are significantly related, the total

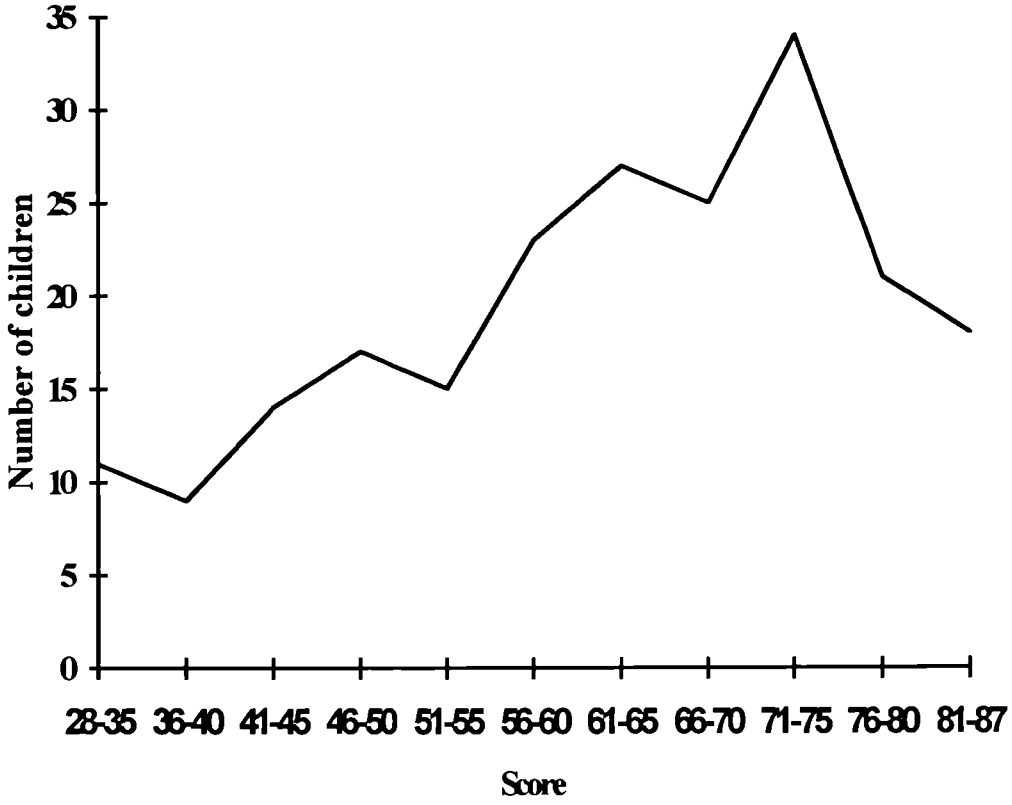


Figure 6.5
Frequency Distribution of scores in the verbal ability test

Table 6.2

Correlations coefficients between correct scores in the different spelling tasks and grammatical awareness tasks

	/e/ sound correct	/i/ sound correct	word analogy	sentence analogy	productive morphology
/o/ sound correct	.54 p=.000	.84 p=.000	.69 p=.000	.71 p=.000	.54 p=.000
/e/ sound correct	-	.56 p=.000	.51 p=.000	.50 p=.000	.44 p=.000
/i/ sound correct	-	-	.71 p=.000	.77 p=.000	.57 p=.000
word analogy	-	-	-	.87 p=.000	.67 p=.000
sentence analogy	-	-	-	-	.66 p=.000
productive morphology	-	-	-	-	-

N=214

score was used in the regression analyses that follow. However, the same regression analyses were also carried out separately for each spelling pattern and are presented in Appendix 8. The total score was calculated by transforming the scores in each spelling pattern into standardised (z) scores and adding them in order to avoid giving more weight to one of the spelling patterns.

Three fixed order multiple regressions were carried out in order to test the hypothesis that the extent of children's grammatical awareness determines the progress of their spelling. In all the regressions the outcome variable was the children's total score in the three spelling patterns and the two first steps were always age and verbal ability. The third step in each regression was the score in each of the three grammatical awareness tasks. Table 6.3 summarises the results of these regressions.

All the three grammatical awareness tasks significantly predicted the correct spelling of the ending of the words after controlling for age and verbal ability. Sentence analogy was the strongest predictor of the correct spelling of the word endings.

In summary, children's understanding of morphological spellings show significant and specific relationships to their grammatical awareness even after controlling for age and verbal ability.

6.IV. Discussion and Conclusions

6.IV.a. Summary of the results

1. Children's success in spelling one of the ending sounds is closely related to their success in spelling the other ending sounds correctly.

Table 6.3

Results for three Fixed Order Multiple Regressions with correct spelling of the endings of all the words as the outcome Variable

Outcome variable: correct spelling of all the words

	B	SE B	beta	r2 change	F change
Step					
Steps common to all 6 multiple regressions					
1. Age	.021	.001	.719	.518	228.07***
2. Verbal ability	.013	.002	.476	.104	57.82***
The third step in each of the three multiple regressions					
3a. sentence analogy	.601	.095	.413	.060	39.7***
3b. word analogy	.610	.157	.285	.025	15.05***
3c. productive morphology	.017	.006	.155	.014	8.04***

* p<.05; ** p<.01; *** p<.001

2. Fixed order multiple regressions showed that there are strong relationships between children's grammatical awareness and their spelling of ending sounds even after controlling for age and verbal ability.

In the next section, these results are discussed in more detail in relation to the hypothesis of the study.

6.IV.b. Discussion of results

Hypothesis : There is a basis in learning the conventional spelling of morphemes and this is children's developing awareness of grammar.

This hypothesis was supported by the data. Children's ability to use morphological spelling strategies for the ending morphemes of nouns, adjectives and verbs changes dramatically between the ages of 7 and 10 years.

The relation between children's use of morphological spelling strategies and their developing awareness of grammar was confirmed by two kinds of evidence. Firstly, there were significant correlations between different spelling patterns the spelling of which depends on morphology. These strong relationships between the different spelling patterns which depend on morphology show that when children start to use a morphological spelling strategy they do so wherever this is required and not selectively. In this sense these children can be characterised as morphological spellers.

The second evidence is the strong and specific relationships between children's spelling and their score in the grammatical awareness tasks even after controlling for age and verbal ability. All three grammatical awareness tasks, and especially the sentence analogy task, predicted children's scores in the spelling task. These results

clearly show that children's awareness of grammar helps them to adopt the conventional spelling for morphemes.

These results are consistent with Nunes et al. (1997) finding that there is a significant and specific relationship between the use of different types of morphological spelling patterns and also between the understanding and the use of morphological spelling patterns and grammatical awareness. They also found that children in the later stages grasp the reason for these spellings and their mastery is founded on the children's grammatical awareness.

6.IV.c. Conclusions and limitations

The results of the present study reinforced the conclusions from the previous studies by showing that the relationship between children's use of morphological spelling strategies and their developing awareness of grammar is not specific to the English language but also exists in other languages. In the previous studies this relationship was established for the third type of connection between morphology and writing (where the conventional spellings for morphemes flout letter-sound correspondence rules). In the present study this relationship was established for the first type of connection between morphology and writing (where the speller has to decide between two or more acceptable spelling sequences).

A limitation of the present study is that it provides only cross-sectional data. Longitudinal data would be needed to find out whether individual children progress through stages of development of morphological spelling, and how this progress is related to their developing grammatical awareness in oral language. The role of phonological awareness in the development of spelling also needs to be examined in relation to morphological awareness in order to see the role of these two important abilities in literacy acquisition. Lastly, more instances of spelling patterns the

spelling of which depends on morphology should be investigated in order to see whether the phenomenon found in this study accounts for the development of children's morphological spelling in general and not just the specific instances of the final morpheme of nouns, adjectives or verbs.

In Chapter seven, two new instances of morphological spellings are examined in order to see whether there is a more general level of knowledge which allows for learning different instances of morphological spellings.

CHAPTER 7: STUDY 6
IS THERE A MORE GENERAL LEVEL OF KNOWLEDGE THAT HELPS CHILDREN CREATE A NEW FRAMEWORK OF THINKING ABOUT LANGUAGE?

7.I. Introduction

In the previous chapters it was found that Greek children's spelling of the final morpheme in words where there are alternative spelling patterns follows a developmental progression. The high correlations that were observed between the three different instances of morphological spelling examined in the previous study suggest the possibility that the relations between spelling and morphological awareness might be limited to the spelling of the ending of nouns, adjectives and verbs. The examination of new spelling patterns, totally different from those examined in the previous study could offer more strength to this relation and also to the hypothesis that there is a more general level of knowledge that helps children to create a new framework for thinking about language (Nunes, 1998).

Nunes et al. (as in Nunes, 1998) have examined a new instance of morphological spelling, the consistency in the use of the stem. In this task children were asked to spell a real word on one day and on another day they asked to spell the same stem in a combination with a real affix but the resultant combined word was a pseudoword. It was found that children's morphological awareness was significantly related to the children's consistency in the spelling of stems even after the effects of age and their general verbal ability were partialled out.

In Greek, morphemes are the key to deciding between alternative spellings for word endings. However, when the phoneme /i/, for example, is in the stem (which is a morpheme that conveys only meaning but does not have grammatical function) it can

be spelled in one of six ways "η, ι, υ, οι, ει, υι[1]". The spelling of the stem of the word can also be based on morphological strategies. For example, in the words "βήχω, /vicho/, I cough and βήχας /vichas/, cough" that share the same stem the phoneme /i/ is spelled with the letter "η". As Bryant et al. (1997) suggest there is an advantage in understanding connections between words with the same stem over the strategy of learning them all in a rote fashion. Thus, for the reasons that I have just given, it is quite impossible to spell Greek words just on the basis of a thorough knowledge of letter-sound relationships. One needs to use morphological strategies in spelling as well as phonological ones.

Morphological awareness is not only related to spelling. Nunes et al. (as in Nunes 1998) have examined whether children's morphological awareness and use of morphological spelling strategies help children to interpret unknown words. According to their hypothesis, a child who realises that "bicycle" is a vehicle with two wheels and "tricycle" is one with three wheels and connects the affix 'bi' with the meaning of "two of something" then it might be easier for this child to understand the word "bidirectorial" or "bipedal". In their study they combined real stems with real affixes in a new combination (e.g. unclimb) and asked children to say what they thought the words meant. They found significant correlations between children's ability to interpret these novel words and their morphological spellings even after the effects of age and general verbal ability were partialled out.

These two new instances of the use of morphological knowledge lead to the more general hypothesis "that the acquisition of morphological spellings provides children with a framework for thinking about language" (Nunes, 1998, p. 16). This new framework applies both to the spelling of the words as well as to the interpretation of the words. In spelling children realise that the final morpheme is related to the grammatical category that the words belongs to or that the stem morpheme is spelled

[1] The spelling of the phoneme /i/ with this digraph is very rare and it appears only in very few words.

consistently in every word. In interpretation children understand that morphemes (stems, affixes and suffixes) convey meaning and that this meaning is constant across different words.

Two questions are investigated in this experiment. The first question concentrated on the stem: do children understand the connections between words with the same stem? The hypothesis is that children use their understanding of the connections between words with the same stem and they spell the same stem in different words consistently.

The second question to be asked in this experiment is whether children's morphological awareness and morphological spelling help them to interpret novel words which can be analysed into morphological components. The hypothesis is that children can use their knowledge that morphemes convey meaning and use morphemes from known words in order to interpret unknown words. In addition the hypothesis that there is a more general level of knowledge which allows for learning different specific instances which depend on morphology is examined.

7.II. Method

7.II.a. Participants

The participant were the same 214 children participated in the previous study.

7.II.b. Materials and Procedure

The same spelling task of the final morpheme, the three morphological awareness tasks and a measure of verbal ability described in the previous chapter were given to

children.

In addition a second spelling task was designed to test whether children spell the stems consistently. It consisted of 20 pairs of words and non-words. The first item of the pair was always a word. In the first ten pairs the second item was a real word derived from the first word (e.g. ευγενής - ευγένεια, /evyenis - evyenia/, polite - politeness). In the other ten pairs the first item was a compound word always composed of two stems. The second item for these words was always a non-word which was generated by taking one of the stems of the real word (the first item of the pair) and adding a second real stem but the combination of the two stems was not a real word (e.g. χειροκροτώ - χειροπερπατώ, chirocroto - chiroperpato/, I hand-clap - I hand-walk). The stems were chosen so that to involve spelling patterns that can be spelled at least in two different ways both of them phonologically acceptable (e.g. in the above example the sound /i/ is spelled with the digraph "ει" but there are 4 more letters or digraphs which represent the sound /i/). This task was given in two sessions. In the first session the first word of the pairs was given and in the second the derived words and the non-words (the second item of the pairs) were given.

All the words used in this task were low frequency words taken from children's reading books. The children were asked to spell the words or non-words on paper provided by the experimenter. The words and non-words were presented in isolation. The testing took place in the classroom in two sessions and both the class teacher and the experimenter made sure that all the children had finished the spelling of one word before a new word was introduced. Appendix 6 presents the words and non-words used in this task. Table 7.1 gives several examples of this task.

Lastly, a task was designed to measure the children's use of morphology in interpreting novel words. The task consisted of 28 non-words. All the non-words were created from a real affix (e.g. μονο, /mono/, something that it is only one as in

Table 7.1

Sample words from the stem spelling task and from the interpretation task

A. The stem spelling task

real words

1.. ναυαγός	ναυάγιο	shipwrecked	shipwreck
2. ταλαιπωρώ	ταλαιπωρία	harass	harassment
3. χορεύω	χορευτής	dance	dancer

compound words and non-words

1. ξενο*δουλεύω*	αρρωστο*δουλεύω*	char - illworking
2. *νευρο*χειρούργος	*νευρο*ράφτης	neurosurgeon - neurotalor
3. *κοκκινο*γένης	*κοκκινο*χέρης	red-beard - red-hand

B. The interpretation task

1. ζεσταίνω	ξεζεσταίνω	heat - unheat
2. ευθεία	ανευθεία	straight line - not a straight line
3. κρεβάτι	δικρέβατο	bed - bibeded
4. δάσκαλος	αρχιδάσκαλος	teacher - leaderteacher
5. ακούω	συνακούω	hear - cohear
7. ιδιοκτήτης	μονοϊδιοκτήτης	owner - monoowner
8. λουλούδι	ολολούλουδος	flower - full of flowers

The affixes used in the interpretation task

α-, ξε- : negative
δι- : bi-, twice
αρχι- : best, leader
συν- : together
μονο- : mono-
ολο- : all

"monosyllabic" which means with only one syllable) and a real stem but a stem which is not found in combination with this affix in the Greek dictionary. The words were presented to the children in sentences. The children were asked to say what they think the word means.

The non-words used in this task were derived by joining a real stem and a real affix. Children were individually interviewed in a quiet room in their school. The experimenter read a sentence with the non-word in it to the child and he asked the child what s/he thought the word means. The affixes used were: ξε- negative; α- privative; δι- bi-, twice; αρχι- best, first; συν- con-, with, together; μονο- mono-, one; ολο- very, quite, all. In another two different sessions children had to spell (a) the non-words and (b) the real words without the affix. The spelling took place in the classroom. Examples of this task are given in Table 7.1. The non-words used in this task are presented in Appendix 7.

7.III. Results

The results are presented in three sections. In the first section univariate statistics for each task that the children carried out are described. In the second section the consistency of the stem task is analysed in order to examine whether children understand the connections between words with the same stem. In the third section the relation between children's knowledge of morphemes and their ability to interpret novel words is presented.

7.III.a. Descriptive statistics.

Children's overall performance in the spelling of the words' endings task, in the three grammatical awareness task and in the verbal ability test was presented in

Chapter 6.

7.III.a.i. The stem spelling task

One point was given for the consistent spelling of the stem in both sessions independently of whether it was spelled correctly or wrong. The frequency distributions of the scores for the consistency of stem is presented in Figure 7.1. The maximum possible score was 20 and the mean score was 14.8 (SD 3.03). Children from each younger group performed significantly worse than children from the older groups ($F(3,210)=1021.62$, $p<.0001$). Post-hoc tests showed that there were no significant differences between second and third graders in the consistency of stem.

7.III.a.ii. The interpretation task

For each interpretation the children were given one point if they had used information from both the stem and the affix in order to produce the definition. Frequency distribution of scores is given in Figure 7.2. The distribution of scores is skewed towards the higher scores. The maximum possible score was 28 and the mean score was 20.94 (SD 7.02). A one-way ANOVA showed a significant effect of grade on the interpretation of non-words ($F(3,210)=44.85$, $p<.0001$).

7.III.b. Do children understand the connections between words with the same stem?

It was hypothesised that children use their understanding of the connections between words with the same stem and they spell the same stem consistently in different words because it is easier to learn that the same stem is spelled consistently than to learn the spelling of each word by rote. All the word pairs in this task included spelling patterns that can be spelled with at least more than one, phonologically acceptable, alternative spelling. Significant positive correlations were thus expected between measure of children's consistent spelling of the stem and their grammatical

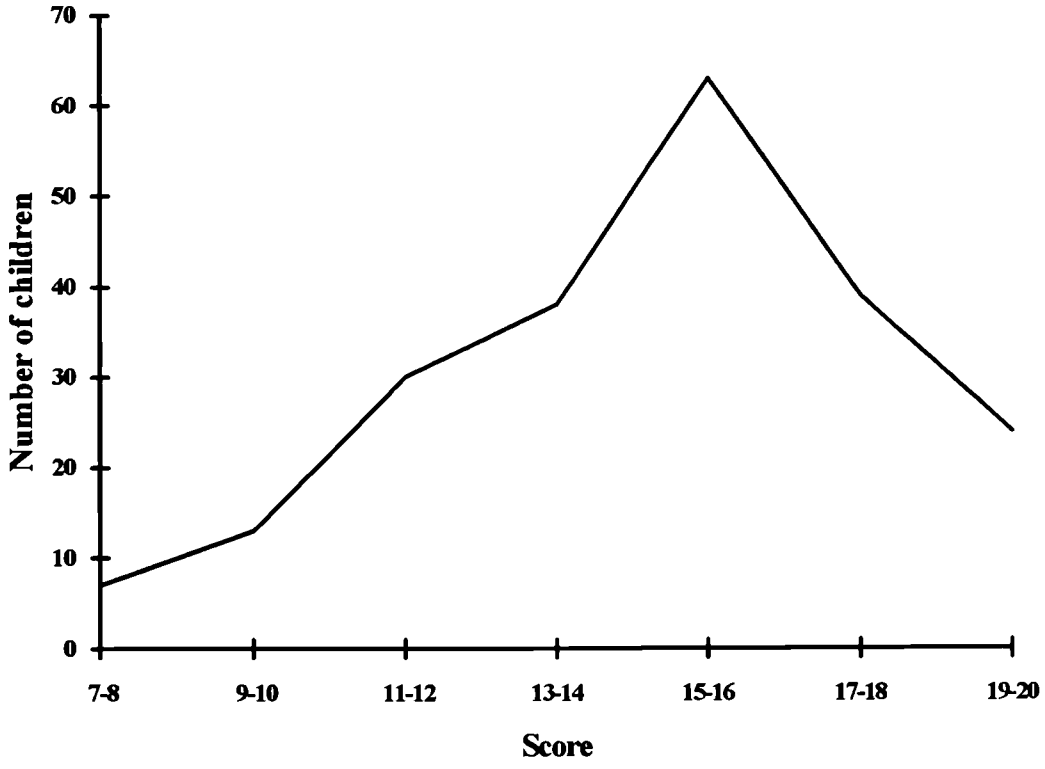


Figure 7.1
Frequency Distribution of scores in the consistency of the stem spelling task

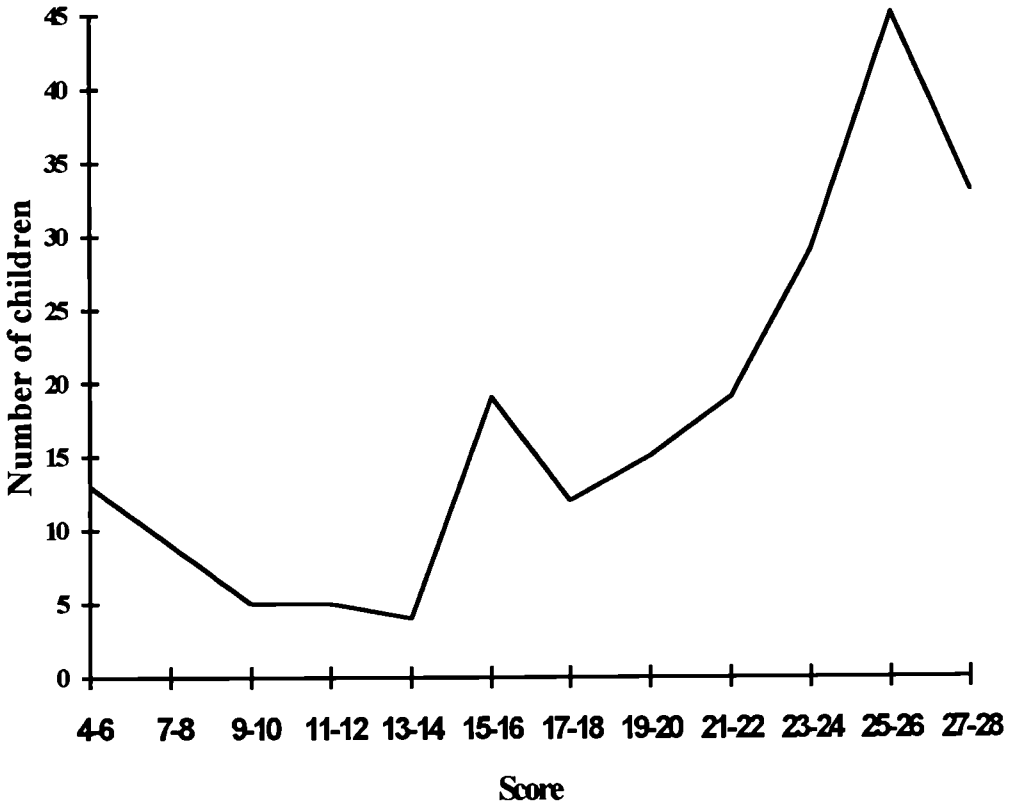


Figure 7.2

Frequency Distribution of scores in the interpretation task

awareness scores. These relationships were expected to remain significant after the effects of age and verbal ability were partialled out.

Relationships between consistent spelling of the stem and grammatical awareness It was predicted that there are specific and significant correlations between children's consistent spelling of the stem and their awareness of grammar. Two types of analyses were carried out. First, correlations across children's consistent spelling of the stem and grammatical tasks were obtained. Correlations coefficients of .58, .58 and .52 between consistent spelling of the stem and sentence analogy, word analogy and productive morphology respectively, were observed. All the correlations were significant.

The second analysis was a series of fixed order multiple regressions, where the children's score in the consistent spelling of the stem was predicted from their grammatical awareness scores controlling for age and verbal ability. The three last steps were scores in the sentence analogy, word analogy and productive morphology tasks. There were three analyses in all. Table 7.2 summarises the results of the three regression analyses. All the three grammatical awareness tasks significantly predicted children's consistent spelling of the stem even after controlling for age and verbal ability.

So the answer to the question this section examined is that children do understand the connections between the words with the same stem and they tend to spell it consistently. In summary, the results of this task corroborate those obtained in the previous studies that children's understanding of morphological spellings shows significant and specific relationships to their grammatical awareness.

Table 7.2

Results for three Fixed Order Multiple Regression with score in the consistent spelling of stem task as the outcome Variable

Outcome variable: score in the consistent spelling of the stem task

	B	SE B	beta	r2 change	F change
Step					
Steps common to all four multiple regressions					
1. Age	.118	.013	.538	.290	86.47***
2. Verbal ability	.079	.017	.371	.063	20.65***
The third step in each of the three multiple regressions					
3a. sentence analogy	.203	.063	.298	.031	10.40**
3b. word analogy	.221	.089	.272	.019	6.23*
3c. productive morphology	.191	.057	.236	.032	11.09**

* p<.05; ** p<.01; *** p<.001

7.III.iii.c. Do children's learning about morphological spellings help them to interpret novel words which can be analysed into morphological components?

This section examines the connection between children's morphological spellings and their ability to interpret novel words that can be analysed into morphological components. The hypothesis is that children's morphological spellings are related with their ability to interpret novel words. This hypothesis leads to the prediction that there will be significant positive correlations between (a) different instances of children's use of morphological spellings and their ability to interpret novel words; (b) their morphological awareness and their ability to interpret novel words. These correlations are expected to remain significant after the effects of age and verbal ability are partialled out, if there is a specific relation between morphological spellings and the interpretation of novel words.

Two measures of children's morphological spellings (spelling the final morpheme and consistent spelling of the stem) and the three measures of their grammatical awareness (sentence analogy, word analogy and productive morphology) were used as predictors of the children's ability to interpret novel words. Because there were high correlations between the scores of the spelling of the three final sounds (/o/, /e/, and /i/) the total score in this task (using the z scores as explained in the previous chapter) was used. The correlation coefficients are presented in Table 7.3. All the correlations were high and significant.

Five multiple regressions, one for each of the measures described above, were carried out to discover whether the correlations between the measures of morphological spellings and grammatical awareness and interpretation of novel words remained significant when age and verbal ability were controlled for. In all these regressions the outcome measure was correct interpretation of the novel words. Age and verbal ability were the first two steps and each of the measures used as

Table 7.3
Correlations coefficients between interpretation of novel words and morphological spellings and grammatical awareness scores

	spelling the final morpheme	consistent spelling of stem	sentence analogy	word analogy	productive morphology
interpretation score	.66 p=.000	.53 p=.000	.67 p=.000	.69 p=.000	.53 p=.01
spelling the final morpheme	-	.56 p=.000	.76 p=.000	.78 p=.000	.62 p=.000
consistent spelling of stem	-	-	.58 p=.000	.58 p=.000	.52 p=.000
sentence analogy	-	-	-	.88 p=.000	.67 p=.000
word analogy	-	-	-	-	.69 p=.000
productive morphology	-	-	-	-	-

N=214

predictors of children's ability to interpret novel words was the third step in each regression. Table 7.4 summarises the results of the five regression analyses.

The relationship between children's ability to interpret novel words and their morphological spellings as measured by their performance in the different spelling tasks which require morphological strategies is significant, even after the effects of age and verbal ability have been partialled out. As was expected, there is a strong and consistent connection between using the morphological spelling strategy and the ability to interpret novel words. From the three grammatical awareness tasks, only sentence analogy is significant in predicting the interpretation of novel words score even after controlling for age and verbal ability.

In summary, these results support the idea that children's morphological spellings is significantly related to their ability to interpret novel words which can be analysed into morphological components. When children start to use a morphologically based spelling strategy, they use it successfully with different spelling patterns which depend on morphology and they also acquire a new way of thinking about language. This new way of thinking about language or this more general level of knowledge allows for learning of different morphological instances.

7.IV. Discussion and Conclusions

7.IV.a. Summary of the results

1. Children's understanding of the connections between words with the same stem was closely related to their grammatical awareness even after the effects of age and verbal ability were partialled out.

Table 7.4

Results for five Fixed Order Multiple Regression with score in the interpretation task as the outcome Variable

Outcome variable: score in the interpretation task

	B	SE B	beta	r2 change	F change
Step					
Steps common to all five multiple regressions					
1. Age	.312	.028	.612	.375	126.94***
2. Verbal ability	.330	.033	.669	.205	102.79***
The third and final step in each of the five multiple regressions					
3a. spelling the final morpheme	.451	.181	.181	.012	6.25*
3b. consistent spelling of stem	.324	.127	.140	.013	6.51*
3c. word analogy	.265	.166	.141	.005	2.54
3d. sentence analogy	.235	.120	.149	.008	3.86*
3e. productive morphology	.121	.110	.065	.002	1.22

* p<.05; ** p<.01; *** p<.001

2. Children's ability to interpret novel words which can be analysed into morphological components was significantly related to their spelling of the ending /o/ and /i/ sounds, to their consistent spelling of the stem morpheme and to one measure of their grammatical awareness namely sentence analogy.

In the next section, these results are discussed in more detail in relation to each of the hypotheses of the study.

7.IV.b. Discussion of the results

Hypothesis 1: Children use their understanding of the connections between words with the same stem and they spell consistently the same stem in different words.

This hypothesis was supported by the data. All the correlations between the spelling consistency task and the grammatical awareness tasks were significant even after controlling for age and verbal ability. All the three grammatical awareness tasks predicted consistent spelling of stem morphemes in related words, even after controlling for age and verbal ability, confirming the relation between reflection on morphology in oral language and its use in written language.

The results of the present study confirm the findings of previous researchers in showing that when children start to use a morphologically based spelling strategy they use it whenever this is required and not only in some instances of morphological spelling. This strategy is used for both the root morphemes (stems) and the inflectional morphemes such as the endings of the verbs, nouns and adjectives.

Hypothesis 2: Children's morphological spellings are related to their ability to interpret novel words which can be analysed into morphological components.

This hypothesis was supported by the data, although not with respect to all the measures. As expected, there were significant correlations between all the measures of children's morphological spelling and grammatical awareness and their ability to interpret novel words. However, the relationship between children's ability to interpret novel words and their score in the word analogy and productive morphology tasks was not significant after controlling for age and verbal ability. All the measures of morphological spelling and the sentence analogy task significantly predicted children's score in the interpretation task even after the same controls have been introduced.

These results show that children who start to adopt a morphologically based spelling strategy also start to develop another way for thinking about their language. This new way of thinking allows them to use their knowledge of morphology in interpreting words that otherwise might not be understood by breaking down these words into morphemes already known. In this way, unknown words in difficult texts, such as scientific texts, can be more easily understood.

These results are consistent with the results of Nunes et al. (1998) who found high correlations between spelling tasks which were based on morphology and children's ability to interpret novel words, even after controlling for age and verbal ability. In their study they also found that the acquisition of morphological spellings provides children with a framework for thinking about language.

7.IV.a. Conclusions and limitations

Study 6 has shown that when children are learning to spell morphologically they can

use this knowledge in different tasks which depend on morphology. There were strong and specific relationships between children's scores on different tasks that depend on morphology. This is very important for the Greek language because morphology is the only way for spelling correctly not only the final morphemes but also the root morphemes. As was found, children's morphological awareness, as it was measured by the three grammatical awareness tasks, predicted their consistent spelling of the stem morpheme, even after controls for age and verbal ability were taken into account.

Another interesting finding is that children's learning of morphology helps them to create a new framework of thinking about language. Once children have understood that morphemes convey the same meaning wherever they are found they are able to decompose novel words into their morphemes and to interpret them based on their previous knowledge. Their ability to interpret novel words is strongly related to their use of a morphologically based strategy in spelling and to their morphological awareness. These relations remain strong even after controlling for age and verbal ability.

A limitation of the present study is that it provides only cross-sectional data examining children's spelling only in one occasion. Longitudinal data would be needed to find out how individual children progress through the development of morphological spelling, and how this progress is related to their developing grammatical awareness in oral language. More instances of spelling patterns the spelling of which depends on morphology would need to be investigated in order to see whether there is a model of the development of children's morphological spelling. Lastly, the role of phonological awareness in the development of spelling also need to be examined in relation to morphological awareness.

In Chapter eight, the conclusions, limitations, and theoretical and educational

implications of the research reported in this thesis will be discussed, and suggestions for further research will be made.

CHAPTER 8
CONCLUSIONS AND GENERAL DISCUSSION

8.I. Conclusions

The major question that this thesis examined was whether literacy acquisition in Greek follows a developmental progression from simple to complex rules (Marsh et al., 1981; Frith, 1985, Goswami and Bryant, 1990, Nunes et al., 1997). The results supported the hypothesis that although Greek is a shallow orthography, a stage model from simple to complex still counts for the development of both reading and spelling. An attempt to describe literacy development in Greek can be made based on the results of this thesis.

In reading, first graders, after just six months of reading and spelling instruction, performed almost at ceiling level in words that involve invariant spelling patterns. This strategy is completely acquired by the first graders as it was shown by their performance in not-frequent words and non-words where they performed at ceiling level. Greek children at the onset of their literacy development use a simple sequential strategy according to which one letter corresponds to one sound. A small problem with words that involve complex syllables was found for the first graders in not-frequent words and non-words. The complexity of the syllable has an effect on young children's reading.

Grade one children's decoding skills develop rapidly. Apart from the one letter for one sound strategy they have also acquired a more complex sequential strategy for the reading of words in which two letters represent one sound. This violation of the one-to-one correspondence has a small effect on first grade children's reading. This effect is limited to not-frequent words and non-words which contain digraphs in complex syllables. First graders performed at ceiling level in words and non-words

that involve digraphs and double letters but they performed slightly worse in the not-frequent words and the non-words with digraphs included in complex syllables. These children sort out the difficulties that they have with not-frequent words with two-to-one constant relations between graphemes and phonemes with context. Their performance is improved when they read these words in sentence context than when they read them in isolation. However, their difficulties with non-words remain. Second grade children have acquired this strategy completely. They performed at ceiling level in words and non-words which have constant two-to-one relations between graphemes and phonemes and context had no effect on their reading of these words.

Words that involve variable but predictable spelling patterns pose the most difficulty in reading. A complex phonological strategy is needed for the reading of these words because the pronunciation of a letter varies in relation to the presence of specific letters or markers in the word. Children of all age groups performed significantly worse in this category of words. Children sort out their difficulties with words that involve variant but predictable spelling patterns with context. When these words were presented in a sentence context children's performance improved significantly. Third graders performed almost at ceiling levels and first graders performed above chance level and benefited more from context than the older age groups.

Conditional rules are not mastered at the same time. Some of them are mastered early; some others are mastered later. In the αυ-ευ combinations conditional rule all the children performed at ceiling level in the frequent words. Second and third grade children performed at ceiling level in not-frequent words too. In non-words all the children performed very low. Even adults had difficulty in reading non-words which involved this conditional rule. More importantly, no child and only five adults knew the grammatical statement for this conditional rule.

Conversely, all the third and second graders and more than half the first graders knew the grammatical statement for the vowel cluster dialitika conditional rule but they did not read correctly all the words and non-words which involved this conditional rule. Similar results were found for the vowel cluster tonos conditional rule although children performed even worse on this conditional rule. Adults read all the words and non words that involved these two conditional rules correctly. Third graders performance shows that by the age of eight years children can read the vast majority of words that involve conditional rules. It might be that in the next two grades these two conditional rules are learned completely with vowel cluster dialitika first and vowel cluster tonos later.

These results show that even if children know the grammatical statement of a rule it does not mean that they have developed the psychological processes which underlie the learning of the rule. The vast majority of second and third graders in the present study knew the grammatical statement for the vowel cluster tonos conditional rule but they could not use it in their reading. It was the most difficult conditional rule for children. The knowledge of the grammatical statement without a complex phonological strategy does not allow for the reading of words with conditional rules. This does not mean that a complex phonological strategy by itself allows for the reading of words with conditional rules. Adults had problems in reading non-words that involved the αυ-ευ combinations conditional rule for which they did not know the grammatical statement. Hence, both the knowledge of the grammatical statement and the use of a complex phonological strategy are important in reading words that involve variant but predictable spelling patterns.

The finding that conditional rules pose a great difficulty on children's reading is consistent with previous research (Marsh et al., 1981). The claim made by Marsh et al. (1981) and by Goswami and Bryant (1990), that children do not learn these rules

till quite late is not supported by the present thesis. This is true for some of the rules. Some others, however, are mastered very early.

In learning conditional rules children use analogy to whole words. Even first graders performed better when they had to read analogous non-words than not-analogous non-words. This strategy, however, is limited because it does not allow for the reading of words that do not share a sequence of letters with another word, and there are a lot of such words. An even more advanced strategy is used for the reading of these words. When children process a word, a segment of which poses great difficulty in decoding, they search for the same segment in a known word and work out its pronunciation. The target segment might not coincide with a phonological segment, for example a syllable, but it may include part of one syllable and part of another syllable. This strategy is used for conditional rules for which the grammatical statement is not available to the reader. Thus readers find their own way of learning these conditional rules. This is a strategy which can be used for conditional rules that have a very complex grammatical statement e.g. the αυ-ευ combinations. The present thesis provides evidence that children from the eight years of age onwards use this strategy. Children's decoding skills are very important for this strategy since the words must be decoded into syllables and even into phonemes in order for the inferences to be made. This explains the finding that this strategy is used by eight years old children who have a good level of decoding skills. This strategy is extensively used by adults who do not know the grammatical statement for the conditional rule.

In spelling Greek, too, a similar developmental sequence from simple to complex can be observed. Young children use a phonological strategy in spelling. A great number of second graders used only one letter - the most common one - for spelling the ending of the words ignoring alternative spelling patterns. Older children realise that this strategy cannot be used for the correct spelling of the majority of the words

because there are alternative correct spellings for the same phonemes and grammar decides for the spelling of the word. By grade five children use morphological strategies in spelling the final morpheme of words the spelling of which depends on morphology. Children's use of morphological spelling strategies is highly related with their morphological awareness even after the effects of age and verbal ability were partialled out. Morphological awareness is significantly related with children's use of morphological strategies in spelling.

The use of morphology is not limited to the spelling of the final morpheme. A significant relation between children's consistent spelling of the stem and their grammatical awareness even after controlling for age and verbal ability was found. High relations between children's morphological spelling, their morphological awareness and their ability to interpret novel words which can be analysed into morphological components were found. These high relations between different instances of the use of morphology show that children at some stage acquire a more general level of morphological knowledge which helps them to overcome any difficulties with literacy.

8.II. Discussion

Taken together, all these findings provide some evidence that a dual route model can explain literacy development in Greek. The sublexical route of this model, which works at the level of phonemes and syllables can explain both reading and spelling.

In reading young children rely on bigger than phonemes phonological units, such as syllables, when they are reading. Thus, when the syllable has a complex structure, these children have more difficulty in reading. It might be that children process the words by analysing them into syllables first, and then into phonemes. However, their

decoding skills at the level of phonemes have not yet been developed completely. This possibility is supported by the method of instruction. First graders are taught to analyse words both into syllables and into phonemes. This is also consistent with findings from other researchers that (a) phonological awareness develops from bigger to smaller units as children are exposed more to reading and writing (Bryant et al., 1989; Goswami and Bryant, 1990); (b) that phonological awareness is not a homogenous phenomenon (Hoein et al., 1990; Stanovich, 1992; Goswami and Bryant, 1990; Aidinis and Nunes, 1997); and (c) that syllable awareness is more accessible to young children than phoneme awareness when the syllable is formed by at least two phonemes (Carraher and Rego, 1984; Liberman et al., 1974; Aidinis and Nunes, 1997). Contextual cues and analogy to segments of known words are used by children in order to read words that surpass their decoding skills.

For spelling, the sublexical route is not enough. The lexical route is essential for spelling in Greek because of the one to many correspondences between phonemes and graphemes. However, this route need not operate on the level of whole words but it must involve smaller units such as morphemes. Morphological awareness is very important for correct spelling in Greek and it is the basis for learning morphological spellings.

The results of the present thesis support the idea that there is a more general level of knowledge that allows children to form a new framework of thinking about language (Nunes, 1998). It could be characterised as a framework of thinking morphologically. This new framework of thinking about language allows children not only to spell various words correctly but also to interpret words that can be analysed into morphemes and otherwise might be very difficult, if not impossible, for them to interpret.

Although the present thesis was not designed to compare reading and spelling it seems that spelling in Greek is more difficult than reading. Words with digraphs, for example, were very easy to be read even by first grade children while 75% of second graders did not use the digraph which was the correct spelling of the ending of some words. This thesis cannot provide any answer for this difference but it could be used as the basis for future research.

8.III. Limitations and suggestions for further research

The studies presented in this thesis were entirely cross sectional. This is the most important limitation. Studies with longitudinal designs as well as training studies are needed in order to provide evidence for the development of reading and spelling. Such studies would also establish causal connection between factors such as phonological and morphological awareness and the development of reading and spelling.

Longitudinal studies that take into account both phonological and morphological awareness would be helpful in order to clarify the effects of these two important abilities on children's reading and spelling. Studies that compare reading and spelling would also be useful in order to clarify what sort of abilities are engaged in what aspects of the mastery of reading and spelling and the relations between these two skills.

A stronger morphological analysis with more instances of morphological spellings would also be useful in order for the connection between morphology and spelling to be clarified.

8.IV. Educational implications

Together, these findings set important questions for educational research. The present thesis confirmed the results of previous researchers that decoding skills are very important for reading and spelling acquisition. There are instances, however, where decoding skills are not enough. What else can we do for children? How can we teach conditional rules?

Morphological awareness is important for spelling. Do we have to teach morphological awareness in order to improve spelling or do we have to teach spelling or both? Training studies which employ both morphological awareness and spelling would give an answer to this question.

Lastly, the present thesis provides a basis for the construction of reading and spelling tests currently not available for the Greek language.

In conclusion, the evidence so far supports the hypothesis that literacy develops from basic simple rules to more complex ones. Different strategies are used by children at different stages of this development. These strategies may differ for reading and spelling but this cannot yet be concluded with certainty. More detailed research is needed to clarify what strategies are used in what aspects of the mastery of reading and writing in Greek. More importantly, studies with longitudinal designs and training studies are needed in order to provide evidence of what causes the development of reading and spelling.

References

Adams, M. J. & Huggins, W. F. (1985). The growth of children's sight vocabulary: a quick test with educational and theoretical implications. Reading Research Quarterly, 20(3), 262-281.

Aidinis, A. (1994). Phonological Awareness in the First Stages of Greek Literacy. Unpublished M.A. Thesis, University of London, Institute of Education.

Aidinis, A. & Nunes, T. (1997). The role of different levels of phonological awareness in the development of reading and spelling Greek. (Paper submitted for publication).

Alegria, J., Pignot, E. & Morais, J. (1982). Phonetic analysis of speech and memory codes in beginning readers. Memory and Cognition, 10(5), 451-456.

Babiniotis, G. (1980). Theoritiki Glossologia (Theoretic Linguistics). Athens: University Press.

Backman, J., Bruck, M., Hebert, M. & Seidenberg, M. S. (1984). Acquisition and Use of Spelling-Sound Correspondences in Reading. Journal of Experimental Child Psychology, 38, 114-133.

Baddeley, A. D., Ellis, N. C., Miles, T. R. & Lewis, V. J. (1982). Developmental and acquired dyslexia: a comparison. Cognition, 11, 185-199.

Badian, N. A. (1994). Do Dyslexic and Other Poor Readers Differ in Reading-Related Cognitive Skills? Reading and Writing: An Interdisciplinary Journal, 6, 45-63.

Baron, J. (1977). What we might know about orthographic rules. In C. Dornic (Eds.), Attention and performance VI. Proceedings of the sixth International Symposium of Attention and Performance, Stockholm, Sweden. (pp. 557-572). New York: Lawrence Erlbaum Associates.

Baron, J. (1979). Orthographic and word-specific mechanisms in children's reading of words. Child Development, 50, 60-72.

Barron, R. W. (1980). Visual and Phonological Strategies in Reading and Spelling. In U. Frith (Eds.), Cognitive Processes in Spelling London: Academic Press.

Barron, R. W. (1986). Word Recognition in Early Reading: A Review of the Direct and Indirect Access Hypotheses. Cognition, 24, 93-119.

Bear, R. D. (1992). The prosody of oral reading and stages of word knowledge. In S. Templeton & D. R. Bear (Eds.), Development of Orthographic Knowledge and the Foundations of Literacy: A memorial Festschrift for Edmund H. Henderson (pp. 137-189). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Beers, C. S. & Beers, J. W. (1992). Children's Spelling of English Inflectional Morphology. In S. Templeton & D. R. Bear (Eds.), Development of Orthographic Knowledge and the Foundations of Literacy: A memorial Festschrift for Edmund. H. Henderson (pp. 231-251). Hillsdale: New Jersey: Lawrence Erlbaum Associates.

Bentin, S. & Frost, R. (1995). Morphological factors in visual word identification in Hebrew. In L. B. Feldman (Eds.), Morphological aspects of language processing (pp. 271-292). Hillsdale: Lawrence Erlbaum Associates.

Berko, J. (1958). The Child's Learning of English Morphology. Word, 14, 150-177.

Bindman, M. R. (1997) Relationships between metalinguistic and spelling development across languages: Evidence from English and Hebrew. Unpublished Ph.D. Thesis, University of London, Institute of Education.

Blachman, B. A., Ball, E. W., Black, R. S. & Tangel, D. M. (1994). Kindergarten Teachers Develop Phoneme Awareness in Low-income, inner-city Classrooms. Reading and writing: An interdisciplinary Journal, 6, 1-18.

Bowey, J. A. (1986). Syntactic Awareness in Relation to Reading Skill and Ongoing Reading Comprehension Monitoring. Journal of Experimental Child Psychology, 41, 282-299.

Bradley, L. & Bryant, P. E. (1983). Categorising Sounds and Learning to Read - A Causal Connection. Nature, 301, 419-521.

Bruck, M. & Treiman, R. (1992). Learning to pronounce words: The limitations of analogies. Reading Research Quarterly, 27(4), 375-388.

Bryant, P. & Bradley, L. (1980). Why children sometimes write words which they do not read. In U. Frith (Eds.), Cognitive processes in spelling London: Academic Press.

Bryant, P. & Bradley, L. (1985). Children's Reading Problems. Psychology and Education. Oxford: Blackwell.

Bryant, P., Devine, M., Ledward, A.,& Nunes, T. (1997). Spelling with apostrophes and understanding possession. British journal of Educational Psychology, 67(1), 91-110.

Bryant, P. & Impley, L. (1986). The Similarities Between Normal Readers and Developmental and Acquired Dyslexics. Cognition, 24, 121-137.

Bryant, P., Nunes, T. & Aidinis, A. (1998). Different morphemes same spelling problems: Cross-linguistic developmental studies (in press).

Bryant, P. E., Bradley, L., MacLean, M. & Crossland, J. (1989). Nursery Rhymes, Phonological Skills and Reading. Journal of Child Language, 16, 407-428.

Bryant, P. E., MacLean, M. & Bradley, L. (1990a). Rhyme, Language, and Children's Reading. Applied Psycholinguistics, 11, 237-252.

Bryant, P. E., MacLean, M., Bradley, L. & Crossland, J. (1990b). Rhyme and Alliteration, Phoneme Detection and Learning to Read. Developmental Psychology, 26(3), 429-438.

Caramazza, A. (1988). Some aspects of language processing revealed through the analysis of acquired aphasia: The lexical system. Annual review in Neuroscience, 11, 395-421.

Caramazza, A., Laudanna, A. & Cristini, R. (1988). Lexical access and inflectional morphology. Cognition, 28, 297-334.

Caramazza, A., Miceli, G., Silveri, C. M. & Laudanna, A. (1985). Reading mechanisms and organisation of the lexicon: Evidence from acquired dyslexia. Cognitive neuropsychology, 2(1), 81-114.

Carlisle, F. J. (1995). Morphological awareness and early reading achievement. In L. B. Feldman (Eds.), Morphological aspects of language processing (pp. 189-209). Hillsdale: Lawrence Erlbaum Associates.

Carlisle, J. (1988). Knowledge of derivational morphology and spelling ability in fourth, sixth and eighth graders. Applied Psycholinguistics, 9, 247-266.

Carraher-Nunes, T. (1987). Illiteracy in a literate society: Understanding reading failure in Brazil. In D. Wagner (Eds.), The future of literacy in a changing world (pp. 95-110). Oxford: Pergamon Press.

Carrillo, M. (1994). Development of Phonological Awareness and Reading Acquisition. Reading and Writing: An Interdisciplinary Journal, 6, 279-298.

Cary, L. & Verhaeghe, A. (1994). Promoting Phonemic Analysis Ability Among Kindergarteners. Reading and Writing: An Interdisciplinary journal, 6, 251-278.

Chialant, D. & Caramazza, A. (1995). Where is morphology and how is it processed? The case of Written word recognition. In L. B. Feldman (Eds.), Morphological aspects of language processing (pp. 55-76). Hillsdale: Lawrence Erlbaum Associates.

Chomsky, N. (1970). Phonology and Reading. In H. Levin & P. J. Williams (Eds.), Basic Studies on Reading (pp. 3-18). New York: Basic Books, Inc., Publishers.

Coltheart, V., Laxon, V. J., Keating, G. C.,& Pool, M. M. (1986). Direct Access and Phonological Encoding Processes in Children's Reading: Effects of Word Characteristics. British Journal of Educational Psychology, 56, 255-270.

Davies, P. & Williams, P. (1974). Aspects of early reading growth: A longitudinal study. Schools Council Research and Development Project in Comprehensive Education. Oxford: Basil Blackwell.

Defior, S. & Tudela, P. (1994). Effect of Phonological Training on Reading and Writing Acquisition. Reading and Writing: An Interdisciplinary Journal, 6, 299-320.

Derwing, B. L., Smith, M. L. & Wiebe, G. E. (1995). On the role of spelling in morpheme recognition: Experimental studies with children and adults. In L. B. Feldman (Eds.), Morphological aspects of language processing (pp. 3-28). Hillsdale: Lawrence Erlbaum Associates.

Doctor, E. A. & Coltheart, M. (1980). Children's Use of Phonological Encoding when Reading for Meaning. Memory and Cognition, 8, 195-209.

Ehri, C. L. (1992a). Review and Commentary: Stages of spelling development. In S. Templeton & D. R. Bear (Eds.), Development of Orthographic Knowledge and the Foundations of Literacy: A memorial Festschrift for Edmund H. Henderson (pp. 307-332). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Ehri, L. C. (1992b). Reconceptualizing the development of sight word reading and its relationship to recoding. In P. Gough, L. Ehri & R. Treiman (Eds.), Reading Acquisition (pp. 107-143). Hillsdale, NJ: Lawrence Erlbaum Associates.

Ehri, L. E. & Robbins, C. (1992). Beginners need some decoding skill to read words by analogy. Reading Research Quarterly, 27(1), 13-26.

Elbro, D. (1990). Differences in dyslexia. A study of reading strategies and deficits in a linguistic perspective. Copenhagen: Munksgaard International Publishers.

Ellis, A. (1984). Reading, Writing and Dyslexia: A Cognitive Analysis. London: Lawrence Erlbaum Associates.

Feldman, L. B. (Ed.). (1995). Morphological aspects of language processing. Hillsdale: Lawrence Erlbaum Associates.

Ferreiro, E., & Teberosky, A. (1983). Literacy before schooling. Exeter: H.E.B.

Foorman, B. R. & Francis, D. J. (1994). Exploring Connections Among Reading, Spelling, and Phonemic Segmentation During First Grade. Reading and Writing: An Interdisciplinary Journal, 6, 65-91.

Fowler, E. A. & Liberman, Y. I. (1995). The role of phonology and orthography in morphological awareness. In L. B. Feldman (Eds.), Morphological aspects of language processing (pp. 157-188). Hillsdale: Lawrence Erlbaum Associates.

Fredericksen, J. (1981). Sources of Process Interactions in Reading. In A. Lesgold & C. Perfetti (Eds.), Interactive Processes in Reading Hillsdale, New Jersey: Erlbaum.

Fredericksen, J. R. (1978). Assessment of Perceptual, Decoding and Lexical Skills and their Relation to Reading Proficiency. In A. Lesgold, J. Pellegrino, S. Fokkema & R. Glaser (Eds.), Cognitive Psychology and Instruction New York: Plenum.

Freyd, P. & Baron, J. (1982). Individual Differences in Acquisition of Derivational Morphology. Journal of Verbal Learning and Verbal Behavior, 21, 282-295.

Frith, U. (1980). Unexpected spelling problems. In U. Frith (Eds.), Cognitive processes in spelling London: Academic Press.

Frith, U. (1985). Beneath the Surface of Developmental Dyslexia. In K. Patterson, J. C. Marshall & M. Coltheart (Eds.), Surface Dyslexia: Neuropsychological and Cognitive Studies of Phonological Reading London: Lawrence Erlbaum Associates.

Frith, U. & Snowling, M. (1983). Reading for Meaning and Reading for Sound in Autistic and Dyslexic Children. British Journal of Developmental Psychology, 1, 329-342.

Glushko, R. J. (1979). The organization and activation of orthographic knowledge in reading aloud. Journal of Experimental Psychology: Human, Perception and Performance, 5(4), 674-691.

Gombert, J. E., Bryant, E. P. & Warrick, N. (1997). Children's use of analogy in learning to read and to spell. In C. Perfeti, L. Rieben & M. Fayol (Eds.), Learning to spell. Research, theory and practice across languages. (pp. 221-235). Mahwah: Lawrence Erlbaun Associates.

Goodman, K. S. (1967). Reading: A psycholinguistic guessing game. Journal of the reading specialist, 6, 126-135.

Goodman, K. S. (1982). Miscue analysis: Theory and reality in reading. In F. K. Gollasch (Eds.), Language and literacy: The selected writings of Kenneth S. Goodman Boston: Routledge and Kegan Paul.

Goswami, U. (1986). Children's Use of Analogy in Learning to Read: A Developmental Study. Journal of Experimental Child Psychology, 42, 73-83.

Goswami, U. (1988a). Children's Use of Analogy in Learning to Spell. British Journal of Developmental Psychology, 6, 21-33.

Goswami, U. (1988b). Orthographic Analogies and Reading Development. Quarterly Journal of Experimental Psychology, 40A, 239-268.

Goswami, U. (1990a). Phonological Priming and Orthographic Analogies in Reading. Journal of Experimental Child Psychology, 49, 323-340.

Goswami, U. (1990b). A Special Link Between Rhyming Skills and the Use of Orthographic Analogies by Beginning Readers. Journal of Child Psychology and Psychiatry, 31(301-311).

Goswami, U. (1991). Learning About Spelling Sequences: The Role of Onsets and Rimes in Analogies in Reading. Child Development, 62, 1110-1123.

Goswami, U. (1992). Analogical reasoning in children. Hove: Lawrence Erlbaum Associates.

Goswami, U. (1993). Toward an interactive analogy model of reading development: Decoding vowel graphemes in beginning reading. Journal of Experimental Child Psychology, 56, 443-475.

Goswami, U. & Bryant, P. (1990). Phonological Skills and Learning to Read. Exeter: Lawrence Erlbaum Associates.

Goswami, U. & Bryant, P. (1992). Rhyme, analogy, and children's reading. In P. B. Gough, L. Ehri & R. Treiman (Eds.), Reading acquisition. Hillsdale, NJ: Lawrence Erlbaum Associates.

Goswami, U. & Mead, F. (1992). Onset and Rime Awareness and Analogies in Reading. Reading Research Quarterly, 27, 153-162.

Gough, L. Ehri & R. Treiman (Eds.), Reading acquisition (pp. 49-63). Hillsdale, NJ: Lawrence Erlbaum Associates.

Gough, P. B. (1983). Context, form and interaction. In K. Rayner (Eds.), Eye movements in reading: Perceptual and language processes (pp. 203-211). San Diego: Academic Press.

Gough, P. B. & Walsh, M. (1991). Chinese, Phoenicians, and the orthographic cipher of English. In B. S. & S. D. (Eds.), Phonological processes in literacy (pp. 199-209). Hillsdale: Lawrence Erlbaum Associates.

Goulandris, A & Snowling, M. (1991). Visual memory deficits: A plausible cause of developmental dyslexia? Evidence from a single case study. Cognitive Neuropsychology, 8, 127-154.

Goulandris, N. K. (1991). Alphabetic spelling: Predinging eventual literacy attainment. In C. M. Sterling & C. Robson (Eds.), Psychology, spelling and education (pp. 143 - 158). Clevedon, Avon, UK: Multilingual Matters.

Guthrie, J. T. (1973). Reading Comprehension and Syntactic Responses in Good and Poor Readers. Journal of Educational Psychology, 65(3), 294-299.

Hoien, T., Lundeberg, I., Stanovich, K. E. & Bjaalid, I. (1995). Components of Phonological Awareness. Reading and Writing: An Interdisciplinary Journal, 7, 171-188.

Hulme, C. & Snowling, M. (Ed.). (1994). Reading Development and Dyslexia. Newcastle upon Tyne: Athenaeum Press.

Humphreys, G. W. & Evett, L. J. (1985). Are there independent lexical and nonlexical routes in word processing? An evaluation of the dual-route theory of reading. The Behavioral and Brain Sciences, 8, 689-740.

Jorm, A. (1977). Effect of Word Imagery on Reading Performance as a Function of Reader Ability. Journal of Educational Psychology, 69(1), 46-54.

Jorm, A. F., Share, D. L., Maclean, R. & Matthews, R. (1984). Phonological Confusability in Short- Term Memory for Sentences as a Predictor of Reading Ability. British Journal of Psychology, 75, 393-400.

Kelliher, S. & Henderson, L. (1990). Morphologically based frequency effects in the recognition of irregularly inflected verbs. British Journal of Psychology, 81, 527-539.

Kim, Y. H. & Goetz, E. T. (1994). Context effects on word recognition and reading comprehension of poor and good readers: A test of the interactive-compensatory hypothesis. Reading Research Quarterly, 29(1), 179-188.

Kirtley, C., Bryant, P., MacLean, M. & Bradley, L. (1989). Rhyme, rime, and the onset of reading. Journal of Experimental Child Psychology, 48, 224-245.

Lahey, M., Liebergott, J., Chesnick, M., Menyuk, P. & Adams, J. (1992). Variability in Children's Use of Grammatical Morphemes. Applied Psycholinguistics, 13, 373-398.

Lundberg, I. (1991). Phonemic awareness can be developed without reading instruction. In S.A. Brady & D.P. Shankweiler (Eds.), Phonological processes in literacy (pp. 47-53). Hillsdale: Lawrence Erlbaum Associates.

Mackridge, P. (1985). The Modern Greek Language. London: Oxford University Press.

Mann, V. A., Tobin, P. & Wilson, R. (1987). Measuring Phonological Awareness Through the Invented Spelling of Kindergarten Children. Merrill-Palmer Quarterly, 33(No.3), 365-391.

Marsh, G. & Desberg, P. (1983). The Development of Strategies in the Acquisition of Symbolic Skills. In D. R. Rogers & J. A. Sloboda (Eds.), The Acquisition of Symbolic Skills (pp. 149-154). New York: Plenum.

Marsh, G., Desberg, P. & Cooper, J. (1977). Developmental changes in strategies of reading. Journal of Reading Behavior, 9, 391-394.

Marsh, G., Friedman, M., Welch, V. & Desberg, P. (1981). A Cognitive-Developmental Theory of Reading Acquisition. In G. E. MacKinnon & T. G. Waller (Eds.), Reading Research: Advances in Theory and Practice (pp. 199-221). New York: Academic Press.

Marsh, G., Friedman, M. P., Welch, V. & Desberg, P. (1980). The Development of Strategies in Spelling. In U. Frith (Eds.), Cognitive Processes in Spelling London: Academic Press.

Martins, C. C. (1994). Rhyme perception: global or analytical? Journal of Experimental Child Psychology, 57, 26-41.

Morais, J. (1995). Do orthographic and phonological peculiarities of alphabetically written languages influence the course of literacy acquisition? Reading and Writing: An Interdisciplinary Journal, 7, 1-7.

Morton, J. (1980). The logogen model and orthographic structure. In U. Frith (Eds.), Cognitive processes in Spelling (pp. 117-133). London: Academic Press.

Morton, J. (1982). Disintegrating the lexicon: An information processing approach. In J. Mehler, E. G. Walker & M. Garett (Eds.), Perspectives on mental representation (pp. 89-109). Hillsdale: Lawrence Erlbaum Associates.

Morton, J. & Patterson, K. (1980). A new attempt at an interpretation, or, an attempt at a new interpretation. In M. Coltheart, K. Patterson & J. C. Marshall (Eds.), Deep Dyslexia (pp. 91-118). London: Routledge & Kegan Paul.

Murell, G. A. & Morton, J. (1974). Word recognition and morphemic structure. Journal of Experimental Psychology, 102(6), 963-968.

Muter, V., Snowling, M. & Taylor, S. (1994). Orthographic analogies and phonological awareness: Their role and significance in early reading development. Journal of Child Psychology and Psychiatry, 35(2), 293-310.

Nicholson, T. (1991). Do children read words better in context or in lists? A classic study revisited. Journal of Educational Psychology, 83(4), 444-450.

Nunes, T. (1998). Developing children's mind through literacy and numeracy. London: Institute of Education, University of London.

Nunes, T. & Aidinis, A. (1998). A closer look at the spelling of children with reading problems (in press).

Nunes, T. & Bryant, P. (1997). Research Manuscript

Nunes, T., Bryant, P. & Bindman, M. (1997a). Morphological Spelling Strategies. Developmental Psychology, 33(4), 637-649.

Nunes, T., Bryant, P. & Bindman, M. (1997b). Spelling and Grammar - The Necsed Move. In C. Perfetti, L. Rieben & M. Fayol (Eds.), Learning to Spell (pp. 151-170). Hillsdale: New Jersey: Lawrence Erlbaum Associates.

Nunes, T., Bryant, P. & Bindman, M. (1997). Learning to spell regular and irregular verbs. (in press)

Oakhill, J., Cain, K. & Bryant, P. (1997). Factors that contribute to individual differences in children's comprehension skill. Paper presented at the ESRC Symposium Integrating Research and Practice in Literacy, Institute of Education, University of London, December 4-5.

Olson, R. K., Kliegl, R., Davidson, B. J. & Foltz, G. (1984). Individual and developmental differences in reading disability. In G. E. MacKinnon & G. T. Waller (Eds.), Reading research: Advances in theory and practice (pp. 1-64). London: Academic Press.

Patterson, K. E. & Morton, J. (1985). From orthography to phonology: An attempt at an old interpretation. In K. E. Patterson, J. C. Marshal & M. Coltheart (Eds.), Surface Dyslexia (pp. 335-359). Hillsdale: Lawrence Erlbaum Associates.

Perfetti, C. (1997). The psycholinguistics of spelling and reading. In C. Perfeti, L. Rieben & M. Fayol (Eds.), Learning to spell. Research, theory and practice across languages. (pp. 21-38). Mahwah: Lawrence Erlbaun Associates.

Perfetti, C., Rieben, L. & Fayol, M. (Ed.). (1997). Learning to spell. Research, theory and practice across languages. Mahwah: Lawrence Erlbaun Associates.

Perfetti, C. A. & Hogaboam, T. (1975). Relationship between Single Word Decoding and Reading Comprehension Skill. Journal of Educational Psychology, 67, 461-469.

Peterson, M. E. & Haines, L. P. (1992). Orthographic analogy training with kindergarten: Effects on analogy use, phonemic segmentation, and letter-sound knowledge. Journal of Reading Behavior, 24(1), 109-127.

Porpodas, C. (1989). The phonological factor in reading and spelling of Greek. In P. G. Aaron & R. M. Joshi (Eds.), Reading and writing disorders in different orthographic systems Dordrecht: Klwer Academic Press.

Porpodas, C. (1990). Processes used in children's reading and spelling Greek words. In G. T. Pavlidis (Eds.), Perspectives on Dyslexia New York: John Wiley & Sons.

Porpodas, C. (1993). The relation between phonemic awareness and reading and spelling of Greek words in the first school years. In M. Caretero, M. Pope, R. Simons & J. Pozo (Eds.), Learning and Instruction (pp. 203-217). Oxford: Pergamon Press.

Porpodas, C. D. (1986a). The Effect of Articulatory Suppression on Greek Children's Reading of Greek. Educational Psychology, 6(2), 115-122.

Porpodas, C. D. (1986b). The Role of Orthographic, Shape and Sound Cues in First-Grade Reading of Greek (Paper submitted for publication).

Porpodas, C. D., Pantelis, S. N. & Hantziou, E. (1990). Phonological and lexical encoding processes in beginning readers: Effects of age and word characteristics. Reading and Writing: An Interdisciplinary Journal, 2(3), 197-208.

Rack, J., Hulme, C., Snowling, M. & Wightman, J. (1994). The Role of Phonology in Young Children Learning to Read Words: The Direct-Mapping Hypothesis. Journal of Experimental Child Psychology, 57, 42-71.

Read, C. (1986). Children's creative spelling. London: Routledge and Kegan Paul.

Rego, L. B. & Bryant, P. E. (1993). The Connection Between Phonological, Syntactic and Semantic Skills and Children's Reading and Spelling. European Journal of Psychology of Education, VIII(3), 235-246.

Robeck, M. C. & Wallace, R. R. (1990). The Psychology of Reading: An Interdisciplinary Approach (Second ed.). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Rohl, M. & Pratt, C. (1995). Phonological Awareness, Verbal Working Memory and the Acquisition of Literacy. Reading and Writing: An Interdisciplinary Journal, 7, 327-360.

Schlagal, R. C. (1992). Patterns of orthographic development into the intermediate grades. In S. Templeton & D. R. Bear (Eds.), Development of Orthographic Knowledge and the Foundations of Literacy: A memorial Festschrift for Edmund H. Henderson (pp. 31-52). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Sebastian-Galles, N. & Vacchiano, A. P. (1995). The development of analogical reading in Spanish. Reading and Writing: An Interdisciplinary Journal, 7, 23-38.

Seidenberg, M. S., Waters, G. S., Barnes, M. A. & Tanenhaus, M. (1984). When does Irregular Spelling or Pronunciation influence Word Recognition. Journal of Verbal Learning and Verbal Behavior, 23, 383-404.

Seymour, P. H. & Porpodas, C. D. (1980). Lexical and Non-Lexical Processing of Spelling in Dyslexia. In U. Frith (Eds.), Cognitive Processes in Spelling London: Academic Press.

Seymour, P. K. & Elder, L. (1986). Beginning Reading without Phonology. Cognitive Neuropsychology, 3, 1-36.

Seymour, P. K. & Evans, H. M. (1994). Levels of phonological awareness and learning to read. Reading and Writing: An Interdisciplinary Journal, 6, 221-250.

Smith, F. (1979). Reading without nonsense. New York: Teachers College Press.

Smith, F. (1994). Understanding reading (5 ed.). Hillsdale: Lawrence Erlbaum Associates.

Snowling, M. (1987). Dyslexia. A Cognitive Developmental Perspective. Oxford: Blackwell.

Spear-Swerling, L. & Sternberg, R. J. (1994). The Road Not Taken: An Integrative Theoretical Model of Reading Disability. Journal of Learning Disabilities, 27(No.2), 91-103.

Stanovich, K. (1984). The interactive-compensatory model of reading: A confluence of developmental, experimental and educational psychology. Remedial and Special Education, 5, 11-19.

Stanovich, K. E. (1980). Toward an interactive-compensatory model of individual differences in the development of reading fluency. Reading Research Quarterly, 16(1), 32-71.

Stanovich, K. E. (1986). Mathew effects in reading: Some consequences of individual differences in the acquisition of literacy. Reading Research Quarterly, 21(4), 360-406.

Stanovich, K. E., Cunningham, A. E. & Cramer, B. B. (1984). Assessing Phonological Awareness in Kindergarten Children: Issues of Task Comparability. Journal of Experimental Child Psychology, 38, 175-190.

Sternberg, R. J. (1977). Component processes in analogical reasoning. Psychological Review, 84, 353-378.

Stuart, M. & Coltheart, M. (1988). Does Reading Develop in a Sequence of Stages? Cognition, 30, 139-181.

Taft, M. (1985). The decoding of words in lexical access: A review of the morphographic approach. In D. Besner, T. G. Waller & G. E. MacKinnon (Eds.), Reading research: Advances in theory and practice (pp. 83-123). New York: Academic Press.

Taft, M. (1987). Morphographic Processing: The BOSS Re-emerges. In M. Coltheart (Eds.), The Psychology of Reading London: Lawrence Erlbaum Associates.

Taft, M. (1991). Reading and the mental lexicon. Hove: Lawrence Erlbaum Associates.

Taft, M. & Zhu, X. (1995). The representation of bound morphemes in the lexicon: a Chinese study. In L. B. Feldman (Eds.), Morphological aspects of language processing (pp. 293-316). Hillsdale: Lawrence Erlbaum Associates.

Tager-Flusberg, H. (1985). Putting Words Together: Morphology and Syntax in the Preschool Years. In J. Berk-Gleason (Eds.), The Development of Language Columbus: Ohio: Charles E. Merrill Publishing Company.

Templeton, S. (1983). Using the Spelling/Meaning Connection to Develop Word Knowledge in Older Students. Journal of Reading, 8-14.

Templeton, S. (1992). Theory, Nature, and Pedagogy of Higher-Order Orthographic Development in Older Students. In S. Templeton & D. R. Bear (Eds.), Development of Orthographic Knowledge and the Foundations of Literacy: A memorial Festschrift for Edmund H. Henderson (pp. 253-277). Hillsdale: New Jersey: Lawrence Erlbaum Associates.

Templeton, S. & Bear, D. R. (Ed.). (1992). Development of Orthographic Knowledge and the Foundations of Literacy: A memorial Festschrift for Edmund H. Henderson. Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Tombaidis, D. (1992). Didaskalia tis Neoellinikis Glossas (Teaching of Modern Greek). Thessaloniki: Vanias (in Greek).

Totereau, C., Thevenin, M. G. & Fayol, M. (1997). The development of the understanding of number morphology in written French. In C. Perfeti, L. Rieben & M. Fayol (Eds.), Learning to spell. Research, theory and practice across languages. (pp. 97-114). Mahwah: Lawrence Erlbaun Associates.

Treiman, R. (1993). Beginning to Spell. New York: Oxford University Press.

Treiman, R., Berch, D., Tincoff, R. & Weatherston, S. (1993). Phonology and Spelling: The Case of Syllabic Consonants. Journal of Experimental Child Psychology, 56, 267-290.

Treiman, R., & Cassar, M. (1997). Spelling acquisition in English. In C. Perfeti, L. Rieben & M. Fayol (Eds.), Learning to spell. Research, theory and practice across languages. (pp. 61-80). Mahwah: Lawrence Erlbaun Associates.

Triantaphyllidis, M. (1913). I Orthographia mas (Our orthography). Athens: Estia (in Greek).

Tunmer, W. (1989). The Role of Language-Related Factors in Reading Disability. In D. Shankweiler & I. Liberman (Eds.), Phonology and Reading Disability: Solving the Reading Puzzle (pp. 91-131). Ann Arbor, MI: University of Michigan Press.

Tunmer, W. & Hoover, W. (1992). Cognitive and Linguistic Factors in Learning to Read. In P. Gough, L. Ehri & R. Treiman (Eds.), Reading Acquisition (pp. 175-214). Hillsdale, NJ: Lawrence Erlbaum Associates.

Tunmer, W. E. & Chapman, J. W. (1993). To Guess or not to Guess, that is the question: Metacognitive strategy training, Phonological recoding skill, and Beginning reading. New Zealand Reading Association, 1, 3-14.

Tunmer, W. E. & Chapman, J. W. (in press). Language Prediction Skill, Phonological Recoding Ability, and Beginning Reading.

Tunmer, W. E., Herriman, M. L. & Nesdale, A. R. (1988). Metalinguistic Abilities and Beginning Reading. Reading Research Quarterly, 23, 134-158.

Tunmer, W. E., Nesdale, A. R. & Wright, A. D. (1987). Syntactic Awareness and Reading Acquisition. British Journal of Developmental Psychology, 5(25-34).

Venezky, L. R. (1995). How English is read: Grapheme-phoneme regularity and orthographic structure in word recognition. In I. Taylor & D. R. Olson (Eds.), Scripts and Literacy (pp. 111-129). Dordrecht: Kluwer Academic Press.

Venezky, R. L. (1967). English orthography: its graphical structure and its relation to sound. Reading Research Quarterly, 2(3).

West, R. F. & Stanovich, K. E. (1978). Automatic Contextual Facilitation in Readers of Three Ages. Child Development, 49, 717-727.

Willows, D. M. & Bouchard Ryan, E. (1986). The Development of Grammatical Sensitivity and its Relationship to Early Reading Achievement. Reading Research Quarterly, 21(3), 253-266.

Wimmer, H. & Goswami, U. (1994). The Influence of Orthographic Consistency on Reading Development: Word Recognition in English and German Children. Cognition, 51, 91-103.

Wimmer, H. & Hummer, P. (1990). How German - Speaking first graders Read and Spell: Doubts on the Importance of the Logographic Stage. Applied Psycholinguistics, 11, 349-368.

Wimmer, H., Landerl, K. & Schneider, W. (1994). The Role of Rhyme Awareness in Learning to Read a Regular Orthography. British Journal of Developmental Psychology, 12, 469-484.

Wise, B. W., Olson, R. K. & Treiman, R. (1990). Subsyllabic Units in Computerized Reading Instruction: Onset-Rime Vs. Postvowel Segmentation. Journal of Experimental Child Psychology, 49, 1-19.

Wysocki, K. & Jenkins, J. R. (1987). Deriving Word Meanings Through Morphological Generalization. Reading Research Quarterly, 22(No.1), 66-81.

Zutell, J. (1992). An Integrated View of Word Knowledge: Correlational Studies of the Relationships Among Spelling, Reading, and Conceptual Development. In S. Templeton & D. R. Bear (Eds.), Development of Orthographic Knowledge and the Foundations of Literacy: A memorial Festschrift for Edmund H. Henderson (pp. 213-230). Hillsdale: New Jersey: Lawrence Erlbaum Associates.

Appendix 1
The words and non-words used in Study 1

one-to-one constant relations words

Simple syllable sort words (1-3 syllables)

Words		Non-Words
Frequent	Not-Frequent	Not-Analogous
γάλα	βήχας	λύρο
έχω	έξοδος	κόχω
αέρας	βολίδα	ανόλα
κάνω	δόκανο	βηλάρι
άδικος	φάρος	όβαλο
μιλώ	παροχή	χόσα
ψάρι	καλάθι	ελόγη

Simple syllable long words (3 syllables and above)

Words		Non-Words
Frequent	Not-Frequent	Not-Analogous
μεγαλώνω	ανασηκώνω	βαλοράκο
ξεφωνίζω	επιτυχία	νοριτόλος
δεκάρικο	καθαριότητα	χατεραόμεφος
καλύτερος	ανελέητος	εβετόχελο
αγαπημένος	διαφορετικός	ξαλορεφόμη
παρακαλώ	πονοκέφαλος	ποράφυκο
περιμένω	κελάηδημα	τεκάλορα

Complex syllable

Words		Non-Words
Frequent	Not-Frequent	Not-Analogous
ύπνος	άρμα	αρμόχα
όμορφος	γλάστρα	κόβαστρο
φορτωμένος	σκλάβος	νιρτάλι
πράγμα	ακρωτήρι	προκάτος
άσπρος	βάτραχος	χάγμος
τρέχω	εξάρτημα	πασκλύμα
κρασί	έγχρωμος	λέκρωμα

γάλα (yala milk)
έχω (εcho have)
αέρας (aεras wind)
κάνω (kano do)
άδικος (aδikos unjust)
μιλώ (milo talk)
ψάρι (psari fish)
βήχας (vichas cough)
έξοδος (exoδos exit)
βολίδα (voliδa bullet)
δόκανο (δokano trap)
φάρος (faros lighthouse)
παροχή (parochi supply)
καλάθι (kalaθi basket)
μεγαλώνω (mεyalono grow up)
ξεφωνίζω (xεfonizo shout)
δεκάρικο (dεkariko ten drachmas coin)
καλύτερος (kalitεros better)
αγαπημένος (ayapimεnos beloved)
παρακαλώ (parakalo please)
περιμένω (pεrimεno wait)
ανασηκώνω (anasikono raise slightly)
επιτυχία (εpitichia success)
καθαριότητα (kaθariotita cleanliness)
ανελέητος (anεlεitos pitiless)
διαφορετικός (δiaforεtikos different)
πονοκέφαλος (ponokεfalos headache)
κελάηδημα (kεlIdima chirp)
ύπνος (ipnos sleep)
όμορφος (omorfos beautiful)
φορτωμένος (fortomεnos laden)
πράγμα (prayma thing)
άσπρος (aspros white)
τρέχω (trεcho run)
κρασί (krasi wine)
άρμα (arma chariot)
γλάστρα (ylastra flower-pot)
σκλάβος (sklavos slave)

ακρωτήρι	(akrotiri	cape)
βάτραχος	(vatrachos	frog)
εξάρτημα	(εxartima	accessory)
έγχρωμος	(εychromos	coloured)

two-to-one constant relations words

Digraph words

Words		Non-Words
Frequent	Not-Frequent	Not-Analogous
μπορώ	μπαταρία	λομπάρη
ακούω	πουκάμισο	ντορίδα
αδειάζω	δαγκώνω	φίγκο
κάγκελο	αίθουσα	χαφαίδα
παιδί	ορειβάτης	ξαρούμο
χαίρομαι	αντέχω	σειλάδα
κοντά	τσόφλι	φοτσίρι

Digraph plus consonant words

Words		Non-Words
Frequent	Not-Frequent	Not-Analogous
άντρας	αντλία	αμπρόδα
ομπρέλα	μάντρα	βογκρίλη
γκρίζος	μελίγκρα	ξοντλίο
μπλούζα	σύμπλεγμα	κιμπλή
λαμπρός	συγκλονίζω	ντρίφος
δέντρο	σύγκρουση	ογκλύνη
ντροπή	φάμπρικα	καντρέος

Double letter words

Words		Non-Words
Frequent	Not-Frequent	Not-Analogous
υπάλληλος	ισορροπώ	εκόμμαλη
παππούς	ιππότης	γορίσσα
θάλασσα	κηρύσσω	ξαγγόμι
φεγγάρι	μέταλλο	παλλύφη
κόκκινος	περιττός	βακκέλα
συλλογή	απόκομμα	μαρρόχα
σύννεφο	σύρραξη	ηδαττέρο

μπορώ	(boro	can)
ακούω	(akouo	hear)
αδειάζω	(adiazo	pour out)
κάγκελο	(kagɛlo	rail)
παιδί	(pɛδi	child)
χαίρομαι	(chɛromɛ	be glad)
κοντά	(koda	near)
μπαταρία	(bataria	battery)
πουκάμισο	(poukamiso	shirt)
δαγκώνω	(δagono	bite)
αίθουσα	(ɛθousa	classroom)
ορειβάτης	(orivatis	climber)
αντέχω	(adɛcho	stand)
τσόφλι	(tsofli	shell)
άντρας	(adras	man)
ομπρέλα	(obrɛla	umbrella)
γκρίζος	(grizos	grey)
μπλούζα	(blouza	blouse)
λαμπρός	(labros	bright)
δέντρο	(δɛdro	tree)
ντροπή	(dropi	shyness)
αντλία	(adlia	air-pump)
μάντρα	(madra	walled garden)
μελίγκρα	(mɛligra	greenfly)
σύμπλεγμα	(siblɛyma	cluster)
συγκλονίζω	(siglonizo	shock)
σύγκρουση	(sigrousi	crash)
φάμπρικα	(fabrika	factory)
υπάλληλος	(ipalilos	employee)
παππούς	(papous	grandfather)
θάλασσα	(θalasa	sea)
φεγγάρι	(fɛgari	moon)
κόκκινος	(kokinos	red)
συλλογή	(siloyi	collection)
σύννεφο	(sinɛfo	cloud)
ισορροπώ	(isoropo	balance)
ιππότης	(ipotis	knight)
κηρύσσω	(kiriso	declare)

μέταλλο	(metalo	metal)
περιττός	(peritos	unnecessary)
απόκομμα	(apokoma	scrap)
σύρραξη	(siraxi	brawl)

one-to-one variable relations words

αυ-ευ combination words

Words		Non-Words
Frequent	Not-Frequent	Not-Analogous
αυλή	θαυμάσιος	καταύορος
αυτοκίνητο	ευωδιά	άραυχος
ζηλεύω	αυτόματος	σευθόρι
φεύγω	γεύμα	εύγαρος
ευτυχώς	κατεύθυνση	αυμόλα
ταξιδεύω	καυσαέριο	τευκότης
αυτί	θεριεύω	ταλαύω

Vowel cluster (stress) words

Words		Non-Words
Frequent	Not-Frequent	Not-Analogous
ρολόι	άυλος	γολόιφο
γάιδαρος	ολόιδιος	ζετάιρη
πλάι	θρόισμα	πορύικος
κορόιδο	κομπολόι	νοράικο
νεράιδα	άυπνος	λοφάυρος
Μάιος	δρύινος	αφόινη
τσάι	ψαροκάικο	πορύικος

Vowel cluster (dialitika) words

Words		Non-Words
Frequent	Not-Frequent	Not-Analogous
καΐκι	προϊόν	δαϊρό
χαϊδεύω	λαϊκός	ραβοΐλο
κοροϊδεύω	προϋπόθεση	πεϊχάτο
μαϊμού	παΐδι	ναποϋδή
φαΐ	μυϊκός	γαΐλομα
πλαϊνός	χαϊμαλί	ρεϊδία
σαΐτα	ευνοϊκός	λοδοϊμός

αυλή	(avli	yard)
αυτοκίνητο	(aftokinito	car)
ζηλεύω	(zilεvo	envy)
φεύγω	(fεvyo	leave)
ευτυχώς	(εftichos	hapilly)
ταξιδεύω	(taxidεvo	travel)
αυτί	(afti	ear)
θαυμάσιος	(θavmasios	marvellous)
ευωδιά	(ενοδia	fragrance)
αυτόματος	(aftomatos	automatic)
γεύμα	(yεvma	lunch)
κατεύθυνση	(katεfθinsi	direction)
καυσαέριο	(kafsaεrio	exhaust-gas)
θεριεύω	(θεriεvo	flare up)
ρολόι	(roloi	watch)
γάιδαρος	(yIδaros	donkey)
πλάι	(plI	near)
κορόιδο	(koroiδo	dupe)
νεράιδα	(nεrIδa	fairy)
Μάιος	(MIos	May)
τσάι	(tsI	tea)
άυλος	(Ilos	immaterial)
ολόιδιος	(oloiδios	same as)
θρόισμα	(θroisma	rustle)
κομπολόι	(koboloi	chaplet)
άυπνος	(Ipnos	sleepness)
δρύινος	(δriinos	oak)
ψαροκάικο	(psarokIko	fish boat)
καΐκι	(kIki	caique)
χαϊδεύω	(chIδevo	caress)
κοροϊδεύω	(koroiδevo	ridicule)
μαϊμού	(mImou	monkey)
φαΐ	(fI	food)
πλαϊνός	(plInos	adjacent)
σαΐτα	(sIta	arrow)
προϊόν	(proion	product)
λαϊκός	(lIkos	popular)
προϋπόθεση	(proipoθesi	condition)

παΐδι	(pIδi	rib)
μυϊκός	(miikos	muscular)
χαϊμαλί	(chImali	charm)
ευνοϊκός	(ενnoikos	favourable)

Appendix 2
The words and non-words used in Study 2

αυ-ευ combination

Non-Words	*Analogous Non-Words*	*Words*
καυτάλι	ευγέθεια	ευγένεια
άραυχος	αυτόλατος	αυτόματος
εύγαρος	ευθόα	ευθεία
εύσαρος	παυχιέμαι	καυχιέμαι
καταύορος	αυλόα	αυλαία
εύδοσος	ναυμαρία	ναυμαχία
σευθόρι	εκραίδευση	εκπαίδευση
ταλαύω	ελερεύνηση	εξερεύνηση
πευζώρος	ευρύλωρος	ευρύχωρος
χαύρητο	δαύρο	μαύρο
χεύληρο	απακατεύω	ανακατεύω
αυμόλα	πιευθύνω	διευθύνω
τευκότης	φυρεύω	γυρεύω
εύολη	τεύμα	ρεύμα
τακεύη	ταύτης	ναύτης
αβρίλο	έφολος	έφοδος
καφόρη	βαφτίλω	βαφτίζω
δοφράνο	κάφνη	δάφνη
φλάσορα	λεφρό	νεφρό
δαροβή	κυφλόμυγα	τυφλόμυγα
ροβδέλη	δούφτα	χούφτα
σοφτίδα	κάβγισμα	γάβγισμα
λόφνη	κασαβροχθίζω	καταβροχθίζω
κοβλόδα	αβδέχα	αβδέλα
βγαρόσι	κτάβλος	στάβλος

ευγένεια	(evyenia	politeness)
αυτόματος	(aftomatos	automatic)
ευθεία	(efθia	straight)
καυχιέμαι	(kafchiεmε	boast)
αυλαία	(avlεa	curtain)
ναυμαχία	(navmachia	naval battle)
εκπαίδευση	(εkpεδefsi	education)
εξερεύνηση	(εxεrevnisi	exploration)
ευρύχωρος	(evrichoros	spacious)

μαύρο	(mavro	black)
ανακατεύω	(anakatεvo	mix)
διευθύνω	(diεfθino	manage)
γυρεύω	(yirεvo	ask for)
ρεύμα	(rεvma	power)
ναύτης	(naftis	sailor)
έφοδος	(εfoδos	assault)
βαφτίζω	(vaftizo	baptize)
δάφνη	(δafni	laurel)
νεφρό	(nεfro	kidney)
τυφλόμυγα	(tiflomiya	blind man's buff)
χούφτα	(chufta	palm)
γάβγισμα	(yavyisma	barking)
καταβροχθίζω	(katavrochθizo	swallow)
αβδέλα	(avδela	leech)
στάβλος	(stavlos	stable)

Vowel cluster tonos

Non-Words	*Analogous Non-Words*	*Words*
αφόινη	οπόιδιος	ολόιδιος
κολάιπο	φλάι	πλάι
γολόιφο	άυρος	άυλος
νοράικο	νόι	σόι
αφονόιλος	άυπρος	άυπνος
άυφος	χρύινος	δρύινος
πορύικος	κογκολόι	κομπολόι
γάιφα	κοσόιδο	κορόιδο
πονάυδη	ροχόι	ρολόι
βρυχόιλα	γκάι	τσάι
ζετάιρη	πάιδαρος	γάιδαρος
λοφάυρος	νεζάιδα	νεράιδα
παρύιλο	ψαροδάικο	ψαροκάικο
ξαράιγο	κρόισμα	θρόισμα
νόιφο	φάιος	Μάιος
γοικός	αυγέ	αυγή
κοιάς	αυτέ	αυτί
αμαιγός	καυράκι	λαυράκι
ναύερος	έτοιρος	έτοιμος
λομοίδα	κοίχος	τοίχος
φαιράξο	ποίηλα	ποίημα
αύταλο	αίνουσα	αίθουσα
χοιξάδα	μελαίος	μεσαίος
τοραμοία	αίτα	αίμα
ζαναία	λιαιτητής	διαιτητής

ολόιδιος	(oloiδios	same as)
πλάι	(plI	near)
άυλος	(Ilos	immaterial)
σόι	(soi	descent)
άυπνος	(Ipnos	sleepness)
δρύινος	(δriinos	oak)
κομπολόι	(koboloi	chaplet)
κορόιδο	(koroiδo	dupe)

ρολόι	(roloi	watch)
τσάι	(tsI	tea)
γάιδαρος	(yIδaros	donkey)
νεράιδα	(nεrIδa	fairy)
ψαροκάικο	(psarokIko	fish-boat)
θρόισμα	(θroisma	rustle)
Μάιος	(mIos	May)
αυγή	(avyi	dawn)
αυτί	(afti	ear)
λαυράκι	(lavraki	bassfish)
έτοιμος	(εtimos	ready)
τοίχος	(tichos	wall)
ποίημα	(piima	poem)
αίθουσα	(εθousa	classroom)
μεσαίος	(mεsεos	middle)
αίμα	(εma	blood)
διαιτητής	(diεtitis	referee)

Vowel cluster dialitika

Non-Words	*Analogous Non-Words*	*Words*
δαϊρό	μαϊκού	μαϊμού
ψοΐρος	μοροϊδεύω	κοροϊδεύω
ξοϋτάρος	λαΐδι	παΐδι
καλαϊρός	σαΐβα	σαΐτα
ραβοΐλο	θαΐκι	καΐκι
πεϊχάτο	ραΐ	φαΐ
ταρυϊδός	πραϊνός	πλαϊνός
γοΐρι	χαϊγεύω	χαϊδεύω
ταϊρέγω	σαϊκός	λαϊκός
ναποϋδή	ευζοϊκός	ευνοϊκός
ρεϊδία	λυϊκός	μυϊκός
παρυϊλός	προϋβόθεση	προϋπόθεση
γαΐλομα	γροϊόν	προϊόν
λοδοϊμός	ταϊμαλί	χαϊμαλί
χαφαΐρα	άπειος	άδειος
δοιάφο	είληση	είδηση
παρούλο	βουίκω	βουίζω
ραιμόνι	φουράρο	φουγάρο
ξαλαίφο	έχοιμος	έτοιμος
δοιγάρω	γοιάζω	μοιάζω
πόλειος	υιάς	υιός
γούφολος	ιφιαίτερος	ιδιαίτερος
αμονοιελώ	αποδαιρετώ	αποχαιρετώ
βειλάρη	ναιμός	λαιμός
εναίπα	κίαιτα	δίαιτα

μαϊμού	(mImou	monkey)
κοροϊδεύω	(koroiδevo	ridicule)
παΐδι	(pIδi	rib)
σαΐτα	(sIta	arrow)
καΐκι	(kIki	caique)
φαΐ	(fI	food)
πλαϊνός	(plInos	adjacent)
χαϊδεύω	(chIδevo	caress)

λαϊκός	(lIkos	popular)
ευνοϊκός	(ενnoikos	favourable)
μυϊκός	(miikos	muscular)
προϋπόθεση	(proipoθεsi	condition)
προϊόν	(proion	product)
χαϊμαλί	(chImali	charm)
άδειος	(αδios	empty)
είδηση	(iδisi	a piece of news)
βουίζω	(vouizo	buzz)
φουγάρο	(fouyaro	chimney)
έτοιμος	(ετimos	ready)
μοιάζω	(miazo	resemble)
υιός	(ios	son)
ιδιαίτερος	(iδιετeros	private)
αποχαιρετώ	(apochεrετo	see off)
λαιμός	(lεmos	neck)

Appendix 3
The words and non-words used in Study 3

one-to-one constant relations

Words			Non-Words		
mple	*Simple*	*Complex*	*Simple*	*Simple*	*Complex*
l. Sort	*Syll. Long*	*Syll.*	*Syll. Sort*	*Syll. Long*	*Syll.*
,α	εφημερίδα	ακροβάτης	σέτο	καζόλημα	πεκρίνα
'ός	επιτυχία	περιστέρι	χερόζω	καφυδάτος	ήχλινο
μο	καθαριότητα	σκιάχτρα	δήνα	λομαρίδες	τεστρόφι
ας			λαζέκος		

γάλα	(yala	milk)
εφημερίδα	(εfimεriδa	newspaper)
ακροβάτης	(akrovatis	acrobat)
λαγός	(layos	rabbit)
επιτυχία	(εpitichia	success)
περιστέρι	(pεristεri	pigeon)
ώριμο	(orimo	mature)
καθαριότητα	(kaθariotita	cleanliness)
σκιάχτρα	(skiachtro	scarecrows)
αέρας	(aεras	air)

Two-to-one constant relations

Words			**Non-Words**		
igraph	*Digraph plus consonant*	*Double Letter*	*Digraph*	*Digraph plus consonant*	*Double Letter*
›χαιρετώ	γκρίζο	εκκλησία	περείτι	μπλογάδι	αννήβη
›γάρο	ομπρέλα	φύλλα	δουράγεις	πεντρόλιο	πέρρος
›κάμισο	μπλούζα	σύννεφα	καθαίλιο	καμπράδα	πωλλέτη
ιτήριο	χλιμίντρισε	μέλισσα	ραμπέκι	άγκρηθο	σαμμέρος
ημα	άντρας	αγγούρι	λεγκούδα	ρεντλάσι	φεκκάτος
›ύμπησα	γκρίνια	κατακόκκινος	ντέμορος	φοντρένα	μεγγολίβα
άντα	αντλία	καταρράκτης	νατσώ	ραμάντλημα	τεσσάλα
γκούνης	συγκλόνισε	κομμάτι	θαλαίριο	ταγκλόχι	γεππύρο

αποχαιρετώ	(apoxereto	see off)
γκρίζο	(grizo	grey)
εκκλησία	(εklisia	church)
φουγάρο	(fouyaro	chimney)
ομπρέλα	(obrela	umbrela)
φύλλα	(fila	leafs)
πουκάμισο	(poukamiso	shirt)
μπλούζα	(blouza	blouze)
σύννεφα	(sinεfa	clouds)
εισιτήριο	(isitirio	ticket)
χλιμίντρισε	(chlimidrisε	neighed)
μέλισσα	(mεlisa	bee)
ποίημα	(piima	poem)
άντρας	(adras	man)
αγγούρι	(agouri	cucumber)
ακούμπησα	(akoubisa	touched)
γκρίνια	(grinia	grizzing)
κατακόκκινος	(katakokinos	deep red)
βεράντα	(vεrada	verandah)
αντλία	(adlia	pump)
καταρράκτης	(kataraktis	waterfall)
τσιγκούνης	(tsigounis	miser)
συγκλόνισε	(siglonisε	shock)
κομμάτι	(komati	piece)

one-to-one variable relations

Words			**Non-Words**		
αυ-ευ	*Vowel cl.*	*Vowel cl.*	*αυ-ευ*	*Vowel cl.*	*Vowel cl.*
nbination	*Stress*	*Dialitika*	*Combination*	*Stress*	*Dialitika*
›γευμα	ολόιδιος	μαϊμού	καυτάλι	αφόινη	δαϊρό
›σαέρια	άυπνος	κοροϊδεύω	άραυχος	καλάιπο	ραβοΐλο
›θυντής	δρύινα	σαΐτες	καταύορος	γολόιφο	ξοϋτάρος
έντευξη	κομπολόι	φαΐ	σευθόρι	άυφος	πεϊχάτα
ή	ρολόι	χαϊδεύω	τευκότης	πορύικο	ταρυϊδό
›άγιο	τσάι	μυϊκή	πευζώρο	βρυχόιλα	ναποΰδη
›τεύουσα	νεράιδα	προϊόν	εύγαρος	ζετάιρη	γαΐλομα
›ρα	ψαροκάικο	προϋπαντήσουμε	αυμόλα	ξαράιγο	λοδοϊμό

απόγευμα	(apoγενma	afternoon)
ολόιδιος	(oloiδios	same as)
μαϊμού	(mImou	monkey)
καυσαέρια	(kafsaεria	exhaust-gas)
άυπνος	(Ipnos	sleepness)
κοροϊδεύω	(koroiδενo	ridicule)
διευθυντής	(diεfθintis	director)
δρύινα	(δriina	oak)
σαΐτες	(sItεs	arrows)
συνέντευξη	(sinεdεfxi	interview)
κομπολόι	(koboloi	chaplet)
φαΐ	(fI	food)
ευχή	(εfchi	wish)
ρολόι	(roloi	watch)
χαϊδεύω	(chIdενo	caress)
ναυάγιο	(navayio	shipwreck)
τσάι	(tsI	tee)
μυϊκή	(miiki	muscular)
πρωτεύουσα	(protενousa	capital city)
νεράιδα	(nεrIδa	fairy)
προϊόν	(proion	product)
σαύρα	(savra	lizard)
ψαροκάικο	(psarokIko	fish-boat)
προϋπαντήσουμε	(proipadisoumε	meet)

Sentences

one-to-one constant relations words

Simple syllable sort words

Ο παππούς πίνει γάλα.
Grandfather drinks milk.

Ένα γρήγορο ζώο είναι ο λαγός.
Hare is an animal that runs fast.

Αυτό το φρούτο είναι ώριμο.
This fruit is ripe.

Σήμερα έκανε πολύ κρύο και είχε αέρα.
Today it was very cold and windy.

Simple syllable long words

Ο πατέρας διαβάζει μία εφημερίδα.
The father is reading his newspaper.

Το πάρτυ είχε επιτυχία.
The party was a success.

Στο σχολείο σήμερα εμείς είμαστε η ομάδα καθαριότητας.
Today, we were on cleaning duty at school.

Complex syllable words

Στο τσίρκο είδαμε πολλούς ακροβάτες.
We saw a lot of acrobats in the circus.

Στο μπαλκόνι μας ήρθε και κάθισε ένα άσπρο περιστέρι.
A white dove came and sat on our balcony.

Οι γεωργοί βάζουν στα χωράφια τους σκιάχτρα.
Farmers use scarecrows on their land.

one-to-one constant relations non-words

Simple syllable sort non-words

Στην εκδρομή μας εγώ θα πάρω το σέτο.
On the school trip I' ll bring the seto.

Όταν πεινώ χερόζω.
When I am hungry I herozo.

Η φίλη μου πέρασε από το σπίτι και πήρε τη δήνα.
My friend came around and took the dina.

Ο Τάσος είναι λαζέκος.
Tasos is lazekos.

Simple syllable long non-words

Χθες πήγα και είδα το καζόλημα.
Yesterday I went and saw the kazolima.

Όταν πηγαίνω στο χωριό νιώθω καφυδάτος.
When I go to the village I feel kafidatos.

Η γιαγιά μου χθές μαγείρεψε λομαρίδες.
Yesterday my grandmother cooked lomarides.

Complex syllable non-words

Αυτά τα μπισκότα έχουν πεκρίνα
These buscuits contain pekrina.

Στη γειτονιά μου υπάρχει ένα ήχλινο σπίτι.
In my neighbourhood there is an ichlino house.

Ευτυχώς που δεν έσπασε το τεστρόφι.
Luckily the testrofi did not break.

two-to-one constant relations words

Digraph words

Πριν φύγω για το σχολείο αποχαιρετώ την μαμά μου.
Before I go to school I say goodbye to my mum.

Το εργοστάσιο δίπλα μας έχει ένα μεγάλο φουγάρο.
The factory close to us has a big chimney.

Σήμερα πήγαμε στην αγορά και αγόρασα ένα πουκάμισο.
Today we went to the market and got a shirt.

Όταν μπαίνεις στο λεωφορείο, παίρνεις ένα εισιτήριο.
When you get on the bus, you need to get a ticket.

Στη γιορτή του σχολείου είπα και εγώ ποίημα.
I had a poem to read out for the school presentation.

Κάηκα μόλις ακούμπησα τη σόμπα.
I burned myself on the radiator.

Το καλοκαίρι τρώμε στη βεράντα.
In the summer we have lunch on the veranda.

Ο Πέτρος μετράει πάντα τα λεφτά του, γιατί είναι πολύ τσιγκούνης.
Petros is always counting his money, he is very tight.

Digraph plus consonant words

Ο γάιδαρός μας είναι γκρίζος.
Our donkey is grey.

Η αδερφή μου, μου έκανε δώρο μια ομπρέλα.
My sister gave me an umbrella for a present.

Η μαμά μου αγόρασε μία καινούρια μπλούζα.
My mum bought a new blouse.

Το άλογο σηκώθηκε στα δύο πισινά πόδια και χλιμίντρισε.

The horse stoob on his back legs and neighed.

Την δασκάλα μας ήρθε και την πήρε ο άντρας της με το αυτοκίνητο.
My teacher's husband came around to pick up her in his car.

Το μωρό μας είναι όλο γκρίνια.
Our baby cries all the time.

Στο χωράφι μας βγάζουμε νερό με την αντλία.
We use a pump to get water for our land.

Η είδηση του θανάτου του, με συγκλόνισε.
News of his death, shook me.

Double letter words
Κάθε Κυριακή πρωί πηγαίνω στην εκκλησία.
I go to church every Sunday.

Το φθινόπωρο πέφτουν τα φύλλα.
The leaves fall in the autumn.

Σήμερα ο ουρανός είναι γεμάτος σύννεφα.
Today the sky is full of clouds.

Μέσα στο τριαντάφυλλο που έκοψα ήταν μία μέλισσα.
I cut a rose and there was a bee in it.

Χθές από το περιβόλι μας έκοψα ένα αγγούρι.
Yesterday I cut a cucumber from our garden.

Όταν παίζω μπάλα γίνομαι κατακόκκινος.
When I play football I get very hot.

Πήγαμε στην Έδεσσα για να δούμε τους καταρράκτες.
We went to Edessa to see the waterfalls.

Από το κέικ της μαμάς μου, έφαγα το μεγαλύτερο κομμάτι.
I had the biggest piece of my mum's cake.

two-to-one constant relations non-words

Digraph non-words
Με χτύπησε στο κεφάλι με το περείτι.
He hit me on the head with a periti.

Μήπως πρέπει να δουράγεις νωρίς.
Should you douragis early?

Το φαγητό που μας σέρβιραν ήταν καθαίλιο.
The food they served was kathelio.

Σήμερα είδα μερικές φωτογραφίες από το ραμπέκι.
Today I saw some pictures from the rabeki.

Θα φορέσω το καινούριο μου πουκάμισο με τη λεγκούδα.
I am going to wear my new shirt with the legouda.

Αυτός ο κύριος είναι ντέμορος.
This man is demoros.

Συνήθως στο σχολείο νατσώ.
At school usually natso.

Για να βάψω έβαλα πολλή μπογιά και θαλαίριο.
I used a lot of paint and thalerio to do the painting.

Digraph plus consonant non-words
Το βράδυ που έχει ησυχία ακούς το μπλογάδι.
In the evening when it is all quiet, you can hear the blogadi.

Στο πάρκο ο φίλος μου βρήκε ένα πεντρόλιο.
My friend found a pendrolio in the park.

Με τον πατέρα μου φτιάξαμε την καμπράδα.
We made the kabrada with my daddy.

Στο δρόμο έβαλαν καινούριο άγκρηθο.
They placed a new agritho down our road.

Το απόγευμα θα φέρουν στο σπίτι μας το ρεντλάσι.
In the afternoon they' ll bring us the rentlasi.

Η μαμά μου με έστειλε στο μανάβη να αγοράσω φοντρένα.
My mum sent me to the grocer's to get some fodrena.

Όλοι γέλασαν με το ραμάντλημά του.
They all had a good laugh with his ramadlima.

Μαζί με την εφημερίδα έδιναν και ένα ταγκλόχι.
They were giving away a taglochi with each newspaper.

Double letter mon-words
Δεν θέλω να ξαναπάω στην αννήβη.
I don't want to go to the anivi again.

Μου αρέσει να τρώω το ψωμί μου με πέρρος.
I like eating bread with peros.

Με την μπάλα μου έσπασα την πωλλέτη.
I broke the poleti with my football.

Αν πας στο χωριό, να πάρεις το σαμμέρος μαζί σου.
If you go to the village, you must take the sameros with you.

Ο γάτος μας είναι μαύρος και φεκκάτος.
Our cat is black and fekatos.

Η μαμά μου φοβάται την μεγγολίβα.
My mum is scared of megoliva.

Στην εκδρομή βρήκαμε μία τεσσάλα.
We found a tesala on the school trip.

Στην αρκούδα αρέσει πολύ το γεππύρο.
Bear likes very much gepiro.

one-to-one variable relations words

αυ-ευ Combination words
Θα πάω βόλτα στη θεία μου το απόγευμα.
I' m going to my aunty's in the afternoon.

Η πόλη μας μολύνεται καθημερινά από τα καυσαέρεια.
Our town is full of pollution from the car fumes.

Πριν από την προσευχή, μας μίλησε ο διευθυντής.
The headmaster gave a speech before morning prayer.

Με σταμάτησε μια κυρία στο δρόμο και μου πήρε συνέντευξη.
A lady stopped me down the road and interviewed me.

Πάντοτε στις κάρτες γράφεις μια ευχή.
We always write wishes in cards.

Η τηλεόραση έδειξε εικόνες από το ναυάγιο.
We saw pictures of the sunken ship on TV.

Ο περισσότερος κόσμος ζει στην πρωτεύουσα.
Most people live in the capital city.

Ο Γιάννης έπιασε μια σαύρα.
Gianis got a lizard.

Vowel cluster (stress) words
Ο Πέτρος και ο Γιάννης είναι δίδυμοι και είναι ολόιδιοι.
Petros and Gianis are twins and therefore they are identical.

Ο Κώστας δεν πρόσεχε σήμερα στο μάθημα, γιατί ήταν άυπνος.
Kostas was not attendive during class today, because he was stayed up late.

Σε πολλούς ανθρώπους αρέσουν τα δρύινα έπιπλα.
Many people like oak furniture.

Έκανα δώρο στον παππού μου ένα κομπολόι.
I gave my grandad a rosary for a present.

Η αδερφή μου αγόρασε το πρώτο της ρολόι.
My sister bought her first watch.

Όταν είμαι κρυωμένος, πίνω τσάι.
I have tea only when I am feeling ill.

Τον Πινόκιο τον προστατεύει η καλή νεράιδα.
Pinokio is protected by a fairy.

Θα πάμε βόλτα με το ψαροκάικο του θείου μου.
We' ll go for a boat ride with my uncle's fishboat.

Vowel cluster (dialitika) words
Στο ζωολογικό κήπο έφεραν μία μαϊμού.
They just brought a monkey to the zoo.

Αν δεν ξέρεις το μάθημα, όλοι σε κοροϊδεύουν.
When you don' t know the lesson, others make fun of you.

Στα παλιά χρόνια πολεμούσαν με σαΐτες.
In ancient times people fought with bows of arrows.

Η γιαγιά μου μαγειρεύει το πιο νόστιμο φαΐ.
My grandmother' s cooking is the best.

Μου αρέσει να χαϊδεύω τη γάτα μας.
I like stroking our cat.

Για να σηκώσεις αυτή την πέτρα, χρειάζεται μεγάλη μυϊκή δύναμη.
You need a lot of muscular strength to lift this rock.

Η πατάτα είναι γεωργικό προϊόν.
Potatoe is agricultural product.

Ήρθε η θεία μου από την Αγγλία και πήγαμε στο αεροδρόμιο να την προϋπαντήσουμε.
My aunt From England came and we went to the airport to meet her.

one-to-one variable relations non-words

αυ-ευ Combination non-words
Δεν μπορώ να έρθω μαζί σου, γιατί θα πάω στο καυτάλι.
I can't come with you because I' ll go to the kaftali.

Ο χυμός που αγόρασα είναι άραυχος.
The juice that I bought is arafchos.

Το καλοκαίρι ο καιρός είναι καταύορος.
In the summer the weather is katavoros.

Η γιαγιά έπλεξε ένα σευθόρι.
Grandmother knitted a sefthori.

Το επάγγελμα του πατέρα μου είναι τευκότης.
My dad works as a tefkotis.

Όλοι στα σπίτια τους έχουν έναν πευζώρο.
Everyone has a pevzoro at home.

Ο κήπος το καλοκαίρι είναι εύγαρος.
The garden in the summer is evgaros.

Οι άνθρωποι τα παλιά χρόνια ταξίδευαν με την αυμόλα.
People travelled by avmola in old times.

Vowel cluster (stress) non-words
Έβαλα τη φωτογραφία πάνω στην αφόινη.
I put the photo on the afoini.

Θα κάνω σχέδια με κολάιπο.
I' ll draw with a kolaipo.

Το καινούριο μας σπίτι είναι γολόιφο.
Our new house is golaifo.

Κάθε φορά που βλέπω το Γιάννη είναι άυφος.
Everytime I see Gianis he is aifos.

Τα λουλούδια για να μεγαλώσουν χρειάζονται πορύικο.
Flowers need poriiko to grow.

Έπεσα και με πονάει η βρυχόιλά μου.
I fell and my vrichoila hurts me.

Σήμερα στο σχολείο πήρα την καινούρια μου ζετάιρη.
I took my new zetairi to school today.

Ο Νίκος ζωγράφισε ένα ξαράιγο.
Nikos drew a xaraigo.

Vowel cluster (dialitika) non-words
Σε λίγη ώρα θα αρχίσει το δαϊρό.
In a few minutes the dairo will start.

Οι πιο πολλοί ναύτες έχουν στα σπίτια τους ραβοΐλο.
Most sailors have a ravoilo at home.

Στο καρναβάλι θα ντυθώ ξοϋτάρος.
I ' ll dress up as a xoitaros for the carnival.

Ο θείος Στρατής μας χαρίζει πεϊχάτα.
My uncle Stratis gives us peichata.

Εμείς δεν ξαναπαίζουμε μαζί σας ταρυϊδό.
We' ll not play tariido with you again.

Η Μαρίνα είναι τυχερή που έχει κοντά στο σπίτι της μία ναποϋδή.
Marina is lucky because she has a napoidi near her house.

Εκεί που παίζαμε μία μπάλα κύλησε μέσα στο γαΐλομα.
While we were playing a ball rolled into the gailoma.

Πήγα στη λαϊκή και αγόρασα ένα λοδοϊμό.
I went to the market and bought a lodoimo.

Appendix 4
The words and non-words used in the first spelling task of Study 4

1. Feminine Nouns and Adjectives -Singular Nominative ending with -η /i/

		non-words
η τσέπη	pocket	η λάφαρη
η κατάψυξη	freezer	η ατόση
η διαφήμιση	advertisement	η καρμόχη
η αποθήκη	store-room	η δοχομπή
η άταχτη	naughty	η ταλάκη
η ανήσυχη	worried	η φοδρόμη
η υπέροχη	marvellous	η νταρισή
η μαρμάρινη	marble	η περόλη

Η τσέπη μου τρύπησε.
I've worn a hole in my pocket.

Η κατάψυξη του ψυγείου μας χάλασε.
Our freezer was broken.

Μου άρεσε η διαφήμιση για τα παιχνίδια.
I liked the advertisement for toys.

Η αποθήκη μας θέλει καθάρισμα.
Our store-room has to be cleaned.

Η Μαρία ήταν άταχτη στο σχολείο.
Maria was naughty at school.

Η μητέρα ήταν ανήσυχη.
The mother was worried.

Η μακαρονάδα της μητέρας μου ήταν υπέροχη.
My mother's pasta was marvellous.

Υπάρχει μια μαρμάρινη σκάλα στο σπίτι της γιαγιάς μου.
There is a marble staircase in my grandmother's house.

2. Neuter Nouns - Singular Nominative ending with -ι /i/

το βαγόνι	wagon (railway)	το τσαλόπι
το ατσάλι	steel	το αγκόφι
το ραβδί	stick	το λοκρί
το μονοπάτι	path	το μαλοφούρι
το πηγούνι	chin	το λοσί
το χωνί	funnel	το πεφάρι
το χαντάκι	ditch	το φεκότι
το σανίδι	floor board	το ραχάκι

Το βαγόνι μας ήταν το νούμερο 25.
Our wagon was number 25.

Το ατσάλι είναι ένα σκληρό μέταλλο.
Steel is a very hard metal.

Το ραβδί της μάγισσας έσπασε.
The witch's stick was broken.

Αυτό το μονοπάτι είναι επικίνδυνο.
That path is dangerous.

Το πηγούνι του Πέτρου ήταν βρώμικο.
Petros's chin was dirty.

Το χωνί ήταν πολύ μεγάλο.
The funnel was very big.

Το χαντάκι ήταν πολύ βαθύ.
The ditch was very deep.

Το σανίδι έσπασε.
This floor board broken.

3. Masculine Nouns and Adjectives - Plural, Nominative ending with -οι /i/

οι λοστρόμοι	boatswain	οι κρομάλοι
οι άγουροι	unripe	οι κάχουροι
οι επικίνδυνοι	dangerous	οι ελέχυτοι
οι διάδρομοι	corridors	οι λόροι
οι κόποι	hard work	οι φερισοί
οι θερινοί	summer	οι αστόλεροι
οι τολμηροί	mettlesome	οι λαρινοί
οι μύθοι	myths	οι μάποι

Οι λοστρόμοι είναι πολύ χρήσιμοι.
The boatswains do a good job.

Οι άγουροι ανανάδες δεν είναι νόστιμοι.
Green pineapples are not tasty.

Οι επικίνδυνοι ληστές φόβισαν τη γειτονιά μας.
People in our neighbourhood are afraid of the dangerous thieves.

Οι διάδρομοι του ξενοδοχείου ήταν πολύ μεγάλοι.
The corridors in the hotel were very long.

Οι κόποι της Μαρίας ανταμείφθηκαν.
Maria's hard work was rewarded.

Όλοι οι θερινοί κινηματογράφοι έκλεισαν.
All the open-air cinemas closed down.

Οι τολμηροί πειρατές ανέβηκαν στο πλοίο.
The mettlesome pirates got on the boat.

Οι μύθοι του Αισώπου μου αρέσουν πολύ.
I like Aesop's myths very much.

4.Verbs - Active Voice, Third Singular Person ending with -ει /i/

λερώνει	dirty	κεσώνει
αντέχει	stand up	αμπέρει
θερίζει	reap	πεσάφει
αστράφτει	lighten	λορίζει
παριστάνει	take off	σταλένει
διορθώνει	correct	βαρίζει
τακτοποιεί	tidy up	σαδώνει
παινεύει	praise	ράιτει

Ο Σάκης λερώνει εύκολα τα ρούχα του.
Sakis often dirties his clothes.

Η αρκούδα αντέχει στο κρύο.
The bear stands up to the cold weather.

Ο αγρότης θερίζει το χωράφι του.
The farmer reaps his land.

Φοβάμαι όταν αστράφτει.
I am afraid of lightening.

Ο Γιώργος παριστάνει το δάσκαλο.
Giorgos takes off the teacher.

Ο δάσκαλος διορθώνει τα διαγωνίσματα.
The teacher corrects our papers.

Η μητέρα τακτοποιεί το σπίτι.
The mother tidies up the house.

Ο δάσκαλος παινεύει τους καλούς μαθητές.
The teacher praises the good students.

5. Neuter Nouns - Singular Nominative ending with -ο /o/

το φουγάρο	chimney	το μέλτο
το ελατήριο	spring	το χάμαρο
το πόμολο	door handle	το ρασητό
το βουητό	clamour	το βάκαλο
το μεροκάματο	a day's work	το πεσαρείο
το περιοδικό	magazine	το κόροσο
το δοχείο	vessel	το σαλιβό
το μαντείο	oracle	το φήριο

Το φουγάρο του εργοστασίου φαίνεται από το σπίτι μου.
I can see the factory's chimney from my house.

Το ελατήριο του ρολογιού μου χάλασε.
The spring of my wach broken down.

Το πόμολο της πόρτας είναι επίχρυσο.
The door handle is golden.

Το βουητό από την τηλεόραση με ενοχλούσε.
The buzzing from the television was annoying.

Ο πατέρας λέει ότι το μεροκάματο δεν φτάνει.
The father says that a day's work is not enough.

Αυτό το περιοδικό βγαίνει κάθε εβδομάδα.
That magazine comes out every week.

Το δοχείο ήταν γεμάτο με λάδι.
The vessel was full of oil.

Τα παιδιά παίζουν το μαντείο.
Children play the oracle.

6. Verbs - Active Voice, First Singular Person ending with -ω /o/

ψηλώνω	grow taller	μοτάνω
διασχίζω	cross	καροδείλω
κυκλοφορώ	walk	ραπαδώνω
ξεριζώνω	uproot	φαραστίζω
κλειδώνω	lock	μορόπτω
οφείλω	owe	καπαροδώ
ζεσταίνω	warm	μαφρώνω
προτείνω	suggest	αδαλώ

Κάθε χρόνο ψηλώνω όλο και περισσότερο.
Every year I grow up a bit..

Για να πάω στο σχολείο διασχίζω ένα μεγάλο δρόμο.
On my way to school I cross a big road.

Συνήθως δεν κυκλοφορώ το βράδυ.
I usually do not walk in the streets at night.

Εγώ ξεριζώνω τα χόρτα του κήπου μας.
I uproot the greens of our garden.

Όταν φεύγω από το σπίτι, κλειδώνω το συρτάρι μου.
When I leave home, I lock my drawer.

Οφείλω 100 δραχμές στην αδερφή μου.
I owe 100 drahmas to my sister.

Ζεσταίνω τα χέρια μου στη σόμπα.
I warm my nands at the stove.

Προτείνω να πάμε στο γήπεδο είπε ο Κώστας.
Let's (I suggest to) go to the football ground Kostas said

7. Verbs - Active Voice, First Plural Person ending with -ε /ε/

φορτώνουμε	load	αμετώνουμε
αραιώνουμε	water down	οφαρούμε
νοικιάζουμε	rent	καλειδίζουμε
σπρώχνουμε	push	ποχτάρουμε
καταστρέφουμε	destroy	σακαρίζουμε
πουλάμε	sale	λαμορούμε
ανυπομονούμε	look forward to	χοκαρώνουμε
αφιερώνουμε	dedicate	καμποσάφουμε

Εμείς φορτώνουμε τα μήλα στο αυτοκίνητο.
We load the apples to the truck.

Τον συμπυκνωμένο χυμό τον αραιώνουμε με νερό.
We watered down the concentrated juice.

Εμείς νοικιάζουμε ένα διαμέρισμα.
We rent a flat.

Κάθε πρωί σπρώχνουμε το αυτοκίνητο για να ξεκινήσει.
Every morning we push our car in order to start.

Το παιχνίδι στον κήπο δεν επιτρέπεται γιατί καταστρέφουμε τα λουλούδια της μαμάς.
We are not allowed to play in the garden becasue we destroy mother's plants.

Στο μαγαζί μας πουλάμε χαλιά.
In our store we sale carpets.

Ανυπομονούμε να έρθουν οι διακοπές.
We look forward to the holidays (to come).

Αφιερώνουμε τη νίκη μας στο σχολείο μας, είπαν τα παιδιά.
We dedicate our victory to our school, children said.

8. Verbs - Passive Voice, Third Singular Person ending with -αι /ε/

κρέμεται	hang	δροκάλεται
κατάγεται	come from	κοσαρέχεται
παραδέχεται	admit	ρελάται
καίγεται	burned	ογάνεται
ταλαιπωρείται	have trouble	βουκαλείται
φωτίζεται	lighten	λαγατίζεται
μεταδίδεται	spread	καλαπίδεται
ονειρεύεται	dream	τοδέμεται

Το ρολόι κρέμεται στον τοίχο.
The clock is hanging on the wall.

Ο δάσκαλός μας κατάγεται από την Μακεδονία.
Our teacher comes from Macedonia.

Ο Γιώργος παραδέχεται πως έκανε λάθος.
Giorgos accepts he has made a mistake.

Το σπίτι του Γιάννη καίγεται.
Giannis' house is burned.

Ο πατέρας μου ταλαιπωρείται κάθε μέρα με τη συγκοινωνία.
My father has troubles every day with the transport.

Το δωμάτιο φωτίζεται με μία λάμπα.
The room is lit by one lamp.

Η ανεμοβλογιά μεταδίδεται εύκολα.
Chicken pox spreads easily.

Ο Πέτρος ονειρεύεται να γίνει γιατρός.
Petros is dreaming to became a doctor.

Appendix 5
The three morphological awareness tasks of Study 5

A.Word Analogy Task.

Practice trials:

1.	βάφω	βάψιμο	paint	painting
	γράφω	γράψιμο	write	writing
2.	δένω	έδεσα	tie	tied
	τρέχω	έτρεξα	run	ran
3.	χαρούμενος	χαρά	happy	happiness
	χαμογελαστός	χαμόγελο	smiling	smile

όμορφη	ομορφιά	beautiful (she)	beauty
νόστιμη	νοστιμιά	tasty (she)	taste
λύνω	έλυσα	untie	untied
βάφω	έβαψα	paint	painted
λέω	είπα	say	said
κατεβαίνω	κατέβηκα	come down	went down
κοιτάζω	κοίταγμα	look	look, glance
τσακίζω	τσάκισμα	shatter	shattering
μαγειρεύω	μάγειρας	cook	cook
ράβω	ράφτης	stitch	tailor
κάνω	έκανα	do	done
έρχομαι	ήρθα	come	came
μαγεύω	μαγεμένος	bewitch	bewitched
κουρδίζω	κουρδισμένος	wind (up)	winded (up)
νίκησε	νικητής	won	winner
ζήλεψε	ζηλιάρης	envied	envious
ακούω	ακούγομαι	hear	be heared
κρατώ	κρατιέμαι	hold	be held
τολμηροί	τόλμη	mettlesome (they)	mettle
ήσυχοι	ησυχία	quiet (they)	quiet
διαβάζω	διαβάζει	read	reads
θέλω	θέλει	want	wants
ταξιδεύω	ταξίδι	travel	travel
κλειδώνω	κλειδί	lock	key
πειράζω	πειράζετε	tease (I)	tease (you plur.)
ρωτώ	ρωτάτε	ask (I)	ask (you plural)
αδικία	άδικος	injustice	unjust
κακία	κακός	wickedness	wicked
συχνά	συχνάζω	frequently	go somewhere frequently
αντίκρυ	αντικρίζω	facing (adv.)	face
γιατρός	γιάτρεψε	doctor	cured
χτίστης	έχτισε	builder	built

B. Sentence Analogy Task.

Practice trials :

1. Η γάτα τρώει ψάρια.	The cat eats fish.
Η γάτα έφαγε ψάρια.	The cat ate fish.
Ο Γιώργος σκάβει τον κήπο.	Giorgos hoes the garden.
Ο Γιώργος έσκαψε τον κήπο.	Giorgos hoed the garden.
2. Εγώ πλένω το αυτοκίνητο.	I wash the car.
Εγώ θα πλύνω το αυτοκίνητο.	I will wash the car.
Εγώ διαβάζω εφημερίδα.	I read newspaper.
Εγώ θα διαβάσω εφημερίδα.	I will read newspaper.

Ο Γιώργος βοηθά την Ελένη.	George helps Helen.
Ο Γιώργος βόηθησε την Ελένη.	George helped Helen.
Η Μαρία πίνει το γάλα της.	Maria drinks her milk.
Η Μαρία ήπιε το γάλα της.	Maria drank her milk.
Ο Μάριος μίλησε με το δάσκαλο.	Marios talked to teacher.
Ο Μάριος μιλάει με το δάσκαλο.	Marios talks to teacher.
Η Κατερίνα άπλωσε τα ρούχα.	Katerina hung out the washing.
Η Κατερίνα απλώνει τα ρούχα.	Katerina hangs out the washing.
Ο Νίκος παίζει μπάλα.	Nikos plays football.
Ο Νίκος θα παίξει μπάλα.	Nikos will play football.
Η γιαγιά ράβει μια μπλούζα.	The grandmother stitches a blouse.
Η γιαγιά θα ράψει μια μπλούζα.	The grandmother will stitch a blouse.
Ο πατέρας βάφει το δωμάτιο.	The father paints the room.
Ο πατέρας έβαψε το δωμάτιο.	The father painted the room.
Εγώ θέλω νερό.	I want water.
Εγώ ήθελα νερό.	I wanted water.
Το παιδί έγραψε ορθογραφία.	The child wrote his spellings.
Το παιδί γράφει ορθογραφία.	The child writes his spellings.
Εγώ ήξερα το δρόμο.	I knew the road.
Εγώ ξέρω το δρόμο.	I know the road.
Εσύ θυμάσαι το καλοκαίρι.	You remember the summer.
Εσύ θυμήθηκες το καλοκαίρι.	You remembered the summer.
Εσύ σηκώνεσαι στις 7.	You wake up at 7.
Εσύ σηκώθηκες στις 7.	You woke up at 7.
Εμείς κοιμηθήκαμε νωρίς.	We slept early.
Εμείς κοιμόμαστε νωρίς.	We sleep early.
Εμείς χαρήκαμε πολύ.	We were very happy.
Εμείς χαιρόμαστε πολύ.	We are very happy.

Αυτοί θα ζωγραφίσουν ένα σπίτι.	They will draw a house.
Αυτοί ζωγραφίζουν ένα σπίτι.	They draw a house.
Οι γείτονές μας θα ψήσουν σουβλάκια.	Our neighbours will grill souvlakia.
Οι γείτονές μας ψήνουν σουβλάκια.	Our neighbours grill souvlakia.
Η μαμά κρύβει το γλυκό.	The mother hides the jam.
Η μαμά θα κρύψει το γλυκό.	The mother will hide the jam.
Ο Χρήστος απαντά τις ερωτήσεις.	Christos answers the questions.
Ο Χρήστος θα απαντήσει τις ερωτήσεις.	Christos will answer the questions.
Εμείς θα ακούσουμε το τραγούδι.	We will listen the song.
Εμείς ακούμε το τραγούδι.	We listen the song.
Εμείς θα δούμε τηλεόραση.	We will watch television.
Εμείς βλέπουμε τηλεόραση.	We watch television.
Κάθε πρωί πλένω το πρόσωπό μου.	Every morning I wash my face.
Κάθε πρωί πλένομαι. (passive voice)	Every morning I wash my face.
Εγώ χτενίζω τα μαλλιά μου.	I brush my hair.
Εγώ χτενίζομαι. (passive voice)	I brush my hair.
Ο γεωργός οργώνει το χωράφι.	The farmer ploughs the field.
Το χωράφι οργώνεται από τον γεωργό.	The field is ploughed by the farmer.
Ο αέρας ξεριζώνει το δέντρο.	The wind uproots the tree.
Το δέντρο ξεριζώνεται από τον αέρα.	The tree is uprooted by the wind.
Ο Κώστας ξυρίζεται.	Kostas shaves himself.
Ο Κώστας ξυρίζει τα γένια του.	Kostas shaves his beard.
Η Μαρία λούζεται.	Maria gives herself a shampoo.
Η Μαρία λούζει τα μαλλιά της.	Maria shampoos her hair.
Το σπίτι γκρεμίζεται από τον εργάτη.	The house is demolished by the worker.
Ο εργάτης γκρεμίζει το σπίτι.	The worker demolish the house.
Το τραπέζι ετοιμάζεται από τη μητέρα.	The dinner is prepared by the mother.
Η μητέρα ετοιμάζει το τραπέζι.	The mother prepares the dinner.

C. Productive Morphology task.
I. Singular - Plural

1. Αυτή είναι μία λοκία. Τώρα υπάρχει ακόμα μία λοκία. Κοίτα υπάρχουν δύο. Είναι δύο _____. (λοκίες)
This is a lokia. Now there is another lokia. Look there two of them. There are two *lokies.*

2. Αυτό είναι ένα καφάτο. Τώρα υπάρχει ακόμα ένα καφάτο. Κοίτα υπάρχουν δύο. Είναι δύο _____. (καφάτα)
This is a kafato. Now there is another kafato. Look there two of them. There are two *kafata.*

3.Αυτός είναι ένας αχόνος. Τώρα υπάρχει ακόμα ένας αχόνος. Κοίτα υπάρχουν δύο. Είναι δύο _____. (αχόνοι)
This is an achonos. Now there is another achonos. Look there two of them. There are two *achoni.*

4.Αυτό είναι ένα λιράφι. Τώρα υπάρχει ακόμα ένα λιράφι. Κοίτα υπάρχουν δύο. Είναι δύο _____. (λιράφια)
This is a lirafi. Now there is another lirafi. Look there two of them. There are two *lirafia.*

II. Present - Past

1. Αυτός είναι ένας κύριος που ξέρει να χαδώνει. Τώρα χαδώνει. Εχθές έκανε το ίδιο πράγμα. Τι έκανε λοιπόν εχθές; Εχθές _____. (χάδωσε)
This is a man who knows how to chadoni. Now he chadoni. He did the same thing yesterday. What did he do yesterday? Yesterday he *chadose.*

2 Αυτός είναι ένας κύριος που ξέρει να μανίζει. Τώρα μανίζει. Εχθές έκανε το ίδιο πράγμα. Τι έκανε λοιπόν εχθές; Εχθές _____. (μάνισε)
This is a man who knows how to manizi. Now he manizi. He did the same thing yesterday. What did he do yesterday? Yesterday he *manise.*

3. Αυτή είναι μία κυρία που ξέρει να αρωνά. Τώρα αρωνά. Εχθές έκανε το ίδιο πράγμα. Τι έκανε λοιπόν εχθές; Εχθές _____. (αρώνησε)
This is a lady who knows how to arona. Now she arona. She did the same thing yesterday. What did she do yesterday? Yesterday she *aronise.*

III. Present - Future

1. Αυτός είναι ένας κύριος που ξέρει να καρώνει. Τώρα καρώνει. Αύριο θα κάνει το ίδιο πράγμα. Τι θα κάνει λοιπόν αύριο; Αύριο _____. (θα καρώσει)
This is a man who knows how to karoni. Now he karoni. He will do the same thing tomorrow. What will he do tomorrow? Tomorrow he *will karosi.*

2. Αυτός είναι ένας κύριος που ξέρει να ντραβίζει. Τώρα ντραβίζει. Αύριο θα κάνει το ίδιο πράγμα. Τι θα κάνει λοιπόν αύριο; Αύριο _____. (θα ντραβίσει)
This is a man who knows how to dravizi. Now he dravizi. He will do the same thing tomorrow. What will he do tomorrow? Tomorrow he *will dravizi.*

3. Αυτή είναι μία κυρία που ξέρει να λαναρεί. Τώρα λαναρεί. Αύριο θα κάνει το ίδιο πράγμα. Τι θα κάνει λοιπόν αύριο; Αύριο _____. (θα λαναρήσει)
This is a lady who knows how to lanari. Now she lanari. She will do the same thing tomorrow. What will she do tomorrow? Tomorrow she *will lanari.*

IV. Third singular person - Third plural person

1. Αυτή είναι μια κυρία που ξέρει να πακεύει. Τώρα κάνει το ίδιο μαζί με ένα φίλο της. Τι κάνουν τώρα και οι δύο; Και οι δύο _____. (πακεύουν)
This a lady who knows how to pakevi. Now she is doing the same thing with her friend. What are they both doing? They *pakevoun.*

2. Αυτή είναι μια κυρία που ξέρει να καλαίνει. Τώρα κάνει το ίδιο μαζί με μια φίλη της. Τι κάνουν τώρα και οι δύο; Και οι δύο _____. (καλαίνουν)
This a lady who knows how to kaleni. Now she is doing the same thing with her friend. What are they both doing? They *kalenoun.*

3. Αυτή είναι μια κυρία που ξέρει να φαραχεί. Τώρα κάνει το ίδιο μαζί με μια φίλη της. Τι κάνουν τώρα και οι δύο; Και οι δύο _____. (φαραχούν)
This a lady who knows how to farachi. Now she is doing the same thing with her friend. What are they both doing? They *farachoun.*

V. Possessive (singular and plural)

1. Αυτή είναι η βοκούρα που έχει μία ομπρέλα. Ποιανής είναι η ομπρέλα; Η ομπρέλα είναι _____. (της βοκούρας)
This is a vokoura who owns an umbrella. Whose umbrella is it? The umbrella is *vokoura's.*

2. Αυτός είναι ο αρούφος που έχει ένα σάντουιτς. Ποιανού είναι το σάντουιτς; Το σάντουιτς είναι _____. (του αρούφου)
This is an aroufo who owns a shandwich. Whose shandwich is it? The shandwich is *aroufo's*

3. Αυτός είναι ο παχατής που έχει ένα καπέλο. Ποιανού είναι το καπέλο; Το καπέλο είναι _____. (του παχατή) Τώρα είναι δύο παχατές. Και οι δύο έχουν καπέλα. Ποιανών είναι τα καπέλα; Τα καπέλα είναι _____. (των παχατών)
This is a pachatis who owns a hat. Whose hat is it? The hat is *pachatis'.* Now there are two pachates. They both own hats. Whose hats are they? The hats are *pachatises'.*

VI. Derived agentives

1. Αυτή είναι μια κυρία που ξέρει να λοκίζει. Πως θα έλεγες κάποια που δουλειά της είναι να λοκίζει; _____. (λοκίστρια)
This is a lady who knows how to lokizi. What would you call a lady whose job is to lokizi? *lokistria*

2. Αυτός είναι ένας κύριος που ξέρει να καλάβει. Πως θα έλεγες κάποιον που δουλειά του είναι να καλάβει; _____. (καλάφτης)
This is a man who knows how to kalavi. What would you call a man whose job is to kalavi? *kalaftis*

3. Αυτός είναι ένας κύριος που ξέρει να χαρώνει. Πως θα έλεγες κάποιον που δουλειά του είναι να χαρώνει; _____. (χαρωτής)
This is a man who knows how to charoni. What would you call a man whose job is to charoni? *charotis*

4. Αυτός είναι ένας κύριος που ξέρει να φαλίζει. Πως θα έλεγες κάποιον που δουλειά του είναι να φαλίζει; _____. (φαλιστής)
This is a man who knows how to falizi. What would you call a man whose job is to falizi? *falistis*

Appendix 6
The words and non-words used in the stem spelling task of Study 6

α) Real Words

ναυαγός	ναυάγιο	shipwrecked	shipwreck
ταλαιπωρώ	ταλαιπωρία	harass	harassement
χορεύω	χορευτής	dance	dancer
οικογένεια	οικογενειακός	family	family (adj.)
καλλιεργώ	καλλιέργεια	cultivate	cultivation
παραγγέλνω	παραγγελία	order	order (noun)
άρρωστος	αρρώστεια	ill	illness
κοροϊδεύω	κορόιδο	ridicule	fool
εγχειρίζω	εγχείρηση	operate	operation
διευθύνω	διευθυντής	manage	manager

b) Non-Words.

ευκολόπιστος	*ευκολότριφτος*	gullible
χειροκροτώ	*χειροπερπατώ*	clap
βιβλιο*πώλης*	παιχνιδο*πώλης*	bookseller
ξενο*δουλεύω*	αρρωστο*δουλεύω*	char
νευροχειρούργος	*νευροράφτης*	neurosurgeon
κοκκινογένης	*κοκκινοχέρης*	red-beard
πετρελαιοπηγή	*πετρελαιοβουνό*	oil-well
πευκόδασος	*πευκοχώραφο*	pine-forest
αστρο*ναύτης*	λιμνο*ναύτης*	astronaut
ψαρο*κάικο*	δελφινο*κάικο*	fishing boat

Appendix 7
The words and non-words used in the interpretation task of Study 6

Practice trials:

στρώνω	ξεστρώνω	settle (down)
ήσυχος	ανήσυχος	quiet
τροχός	δίτροχο	wheel
μάστορας	αρχιμάστορας	foreman
μαθητής	συμμαθητής	pupil
θέση	μονοθέσιο	seat
καινούριο	ολοκαίνουριο	new

αρρωσταίνω	ξαρρωσταίνω	fall ill
ζεσταίνω	ξεζεσταίνω	heat
κοροϊδεύω	ξεκοροϊδεύω	make fun
βραβεύω	ξεβραβεύω	award
ευχαριστημένος	ανευχαριστημένος	pleased
ευθεία	ανευθεία	straight line
λευκός	άλευκος	white
ειρηνικός	ανειρηνικός	peaceful
τιμόνι	διτίμονο	steering-wheel
κρεβάτι	δικρέβατο	bed
τοίχος	δίτοιχο	wall
κουμπί	δίκουμπο	button
δάσκαλος	αρχιδάσκαλος	teacher
παίχτης	αρχιπαίχτης	player
δουλειά	αρχιδουλειά	work
πόλη	αρχίπολη	city
μάγειρας	συμμάγειρας	cook
ακούω	συνακούω	hear
διαβάζω	συνδιαβάζω	read
χορεύω	συγχορεύω	dance
πόρτα	μονόπορτο	door
αυτί	μονόαυτος	ear
ιδιοκτήτης	μονοιδιοκτήτης	owner
δάχτυλο	μονοδάχτυλο	finger
βρώμικος	ολοβρώμικος	dirty
ζεστός	ολόζεστος	hot
κόκκινο	ολοκόκκινο	red
λουλούδι	ολολούλουδος	flower

α-, ξε- : negative
δι- : bi-, twice
αρχι- : best
συν- : together
μονο- : mono-
ολο- : all

Sentences.

Κάθε φορά που τον βλέπω ξαρρωσταίνω.
Every time I see him I unfall ill.

Όταν κάνω μπάνιο ξεζεσταίνομαι.
When I take a shower I unkold.

Εγώ ξεκοροϊδεύω τον Γιώργο που έπεσε.
I unmake fun with Giorgow who is fallen down.

Το σχολείο ξεβραβεύει τους κακούς μαθητές.
School unawards bad students.

Η Κατερίνα είναι ανευχαριστημένη με τους βαθμούς της.
Katerina is unpleased with her grades.

Ζαλίστηκα, γιατί ο δρόμος ήταν ανευθεία.
I felt dizzy because the road was unstraight.

Τα άλευκα δόντια είναι άσχημα.
The unwhite teeth are ugly.

Δεν συμπαθώ τον Γιάννη γιατί είναι ανειρηνικός.
I do not like Gianni because he is unpeaceful.

Αυτό το αυτοκίνητο είναι διτίμονο.
That car is biwheeled.

Το δωμάτιο που νοίκιασα είναι δικρέβατο.
The room I rent is two-bed.

Το σπίτι μας είναι δίτοιχο.
Our house is biwalled.

Έχω ένα δίκουμπο πουκάμισο.
I have a bibuttoned shirt.

Ο αρχιδάσκαλος ήρθε στην τάξη.
The headteacher came to our class.

Ο αρχιπαίχτης του ΠΑΟΚ μίλησε στην τηλεόραση.
PAOK's headplayer spoke on television.

Σερβιτόρος ήταν η αρχιδουλειά μου.
Waiter was my first work.

Η Αθήνα είναι η αρχιπόλη της Ελλάδας.
Athens is the headcity of Greece.

Ο Γιώργος είναι συμμάγειρας με τον Κώστα.
Giorgos is co-cook with Costas.

Συνακούω ραδιόφωνο με την αδερφή μου.
I co-listen to the radio with my sister.

Κάθε απόγευμα συνδιαβάζω με τον αδερφό μου.
Every afternoon I co-read with my brother.

Ο μπαμπάς μου συγχορεύει με την μαμά μου.
My dad co-dances with my mum.

Το σπίτι της γιαγιάς μου είναι μονόπορτο.
My grandmother's house is monodoored.

Είδα έναν κύριο που ήταν μονόαυτος.
I saw a man who was monoear.

Ο θείος μου είναι μονοϊδιοκτήτης αυτού του σπιτιού.
My uncle is the monoowner of this house.

Το πουλάκι που είδαμε ήταν μονοδάχτυλο.
The little bird we saw was monofigered.

Ο Πέτρος γύρισε στο σπίτι ολοβρώμικος.
Petros came home all-dirty.

Πίνω το γάλα μου ολόζεστο.
I drink my milk all-hot.

Το πουκάμισο που αγόρασα είναι ολοκόκκινο.
The shirt I bought is all-red.

Την άνοιξη ο κήπος μας είναι ολολούλουδος.
In spring our garden is all-flowered.

Appendix 8
Statistical Analyses

Results for 6 Fixed Order Multiple Regression with correct spelling of /o/ sound as the outcome Variable

Outcome variable: correct spelling of words ending with /o/

	B	SE B	beta	r2 change	F change
Step					
Steps common to all 6 multiple regressions					
1. Age	.134	.010	.660	.436	163.86***
2. Verbal ability	.075	.014	.383	.067	28.56***
The third, fourth and fifth steps in each of the six multiple regressions					
3a. sentence analogy	.259	.049	.413	.059	28.07***
4a.i. word analogy	.151	.086	.203	.006	3.69
5a.i. productive morphology	.042	.048	.056	.002	.76
4a.ii. productive morphology	.056	.047	.076	.003	1.43
5a.ii. word analogy	.135	.088	.182	.005	2.38
3b. word analogy	.315	.069	.425	.045	21.15***
4b.i. sentence analogy	.191	.062	.305	.019	9.42**
5b.i. productive morphology	.042	.048	.056	.002	.76
4b.ii. productive morphology	.063	.048	.085	.004	1.70
5b.ii. sentence analogy	.182	.063	.292	.017	8.41**
3c. productive morphology	.128	.046	.173	.017	7.58**
4c.i. sentence analogy	.238	.052	.381	.044	21.25***
5c.i. word analogy	.135	.088	.183	.005	2.38
4c.ii. word analogy	.282	.073	.380	.032	14.83***
5c.ii. sentence analogy	.183	.063	.292	.017	8.41**

* p<.05; ** p<.01; *** p<.001

Results for 6 Fixed Order Multiple Regression with correct spelling of /e/ sound as the outcome Variable

Outcome variable: correct spelling of words ending with /e/

	B	SE B	beta	r2 change	F change
Step					
Steps common to all 6 multiple regressions					
1. Age	.129	.013	.571	.326	102.36***
2. Verbal ability	.086	.017	.395	..072	25.07***
The third, fourth and fifth steps in each of the six multiple regressions					
3a. sentence analogy	.092	.064	.132	.006	2.09
4a.i. word analogy	.200	.112	.241	.009	3.19
5a.i. productive morphology	.099	.062	.119	.007	2.54
4a.ii. productive morphology	.116	.061	.141	.010	3.66
5a.ii. word analogy	.164	.114	.198	.006	2.08
3b. word analogy	.202	.087	.244	.015	5.34*
4b.i. sentence analogy	.002	.081	.003	.000	.001
5b.i. productive morphology	.099	.062	.119	.007	2.54
4b.ii. productive morphology	.097	.061	.117	.007	2.51
5b.ii. sentence analogy	-.018	.082	-.025	.000	.047
3c. productive morphology	.131	.057	.159	.015	5.25*
4c.i. sentence analogy	.050	.067	.071	.002	.55
5c.i. word analogy	.164	.114	.198	.006	2.08
4c.ii. word analogy	.150	.093	.181	.007	2.59
5c.ii. sentence analogy	-.018	.082	-.025	.000	.05

* p<.05; ** p<.01; *** p<.001

Results for 6 Fixed Order Multiple Regression with correct spelling of /i/ sound as the outcome Variable

Outcome variable: correct spelling of words ending with /i/

	B	SE B	beta	r2 change	F change
Step					
Steps common to all 6 multiple regressions					
1. Age	.465	.031	.712	.507	218.06***
2. Verbal ability	.302	.040	.480	.106	57.50***
The third, fourth and fifth steps in each of the six multiple regressions					
3a. sentence analogy	.864	.136	.427	.063	40.43***
4a.i. word analogy	.133	.241	.056	.001	.31
5a.i. productive morphology	.138	.134	.058	.002	1.08
4a.ii. productive morphology	.148	.131	.062	.002	1.28
5a.ii. word analogy	.082	.246	.034	.000	.11
3b. word analogy	.827	.197	.345	.030	17.58***
4b.i. sentence analogy	.804	.174	.397	.033	21.33***
5b.i. productive morphology	.139	.134	.058	.002	1.08
4b.ii. productive morphology	.228	.138	.095	.005	2.74
5b.ii. sentence analogy	.776	.176	.383	.030	19.43***
3c. productive morphology	.391	.131	.163	.016	8.77***
4c.i. sentence analogy	.810	.144	.401	.049	31.72***
5c.i. word analogy	.082	.246	.034	.000	.112
4c.ii. word analogy	.704	.210	.294	.019	11.26***
5c.ii. sentence analogy	.776	.176	.384	.030	19.44***

* p<.05; ** p<.01; *** p<.001

Results for 6 Fixed Order Multiple Regression with correct spelling (z score) of the endings of all the words as the outcome Variable

Outcome variable: correct spelling of all the words

	B	SE B	beta	r2 change	F change
Step					
Steps common to all 6 multiple regressions					
1. Age	.137	.009	.715	.512	222.19***
2. Verbal ability	.085	.012	.463	.098	53.15***
The third, fourth and fifth steps in each of the six multiple regressions					
3a. sentence analogy	3.726	.640	.393	.054	33.94***
4a.i. word analogy	.835	1.260	.060	.001	.44
5a.i. productive morphology	.046	.039	.065	.002	1.34
4a.ii. productive morphology	.049	.039	.069	.003	1.58
5a.ii. word analogy	.586	1.277	.042	.000	.21
3b. word analogy	4.061	1.042	.291	.026	15.20***
4b.i. sentence analogy	3.402	.805	.359	.027	17.87***
5b.i. productive morphology	.046	.039	.065	.002	1.34
4b.ii. productive morphology	.071	.040	.101	.005	3.11
5b.ii. sentence analogy	3.251	.815	.343	.025	15.92***
3c. productive morphology	.111	.039	.158	.015	8.12**
4c.i. sentence analogy	3.461	.672	.365	.042	26.51***
5c.i. word analogy	.586	1.277	.042	.000	.21
4c.ii. word analogy	3.452	1.092	.247	.017	9.99**
5c.ii. sentence analogy	3.251	.815	.343	.025	15.92***

* p<.05; ** p<.01; *** p<.001